I

PROJECT MANAGEMENT

Project Vs Functional Management

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PROJECT VS FUNCTIONAL MANAGEMENT

Learning Objectives

After finishing this chapter, you should be able to:

- Compare project management with functional management.
- Describe three basic ideas behind modern project management.
- Describe two basic rules of conduct for project managers.

Toward a Definition of Project Management

A problem situation at System Electronics.

One morning in late March, Ed Jones, the **president** of System Electronics, was reviewing some recent problems connected with one of the company's important contracts. The contract required the company to supply 240 electronic control systems for large fluid drives. The customer was a major manufacturer of fans and fluid drives used in electric power generators. While work had started out very well on the contract, Ed was unhappy with how it had progressed. The project was now experiencing cost overruns and delays in some areas that forced other areas to wait for materials needed to proceed with their work on the project. Because of the present delays, it appeared that additional delays would occur in the future. Ed was most anxious to determine the cause of this problem so that he could prevent further problems on *this* project and use the experience to help future projects run much more smoothly.

Cost overruns and delays accumulate.

Tim Davidson, **project manager**, was in charge of the fluid drive project. After the contract was awarded to System, Tim was given the responsibility for supervising its completion and the coordination among the customer, System's Engineering Department, and System's Production Department. Tim was most enthusiastic about the project six months ago when he first started, but his enthusiasm decreased as problems and frustrations began to mount.

Coordination requires a work consensus.

From Tim's point of view, the major problem was getting Engineering and Production to agree upon what was necessary to complete the project on time and for the stipulated price. Tim had carefully worked out, with the help of his assistant, several diagrams and schedules that showed how the project could be completed on time and on budget. At the start of the actual implementation of the program, Tim thought they were in an excellent position to be

Frustrating communications problems arise.

successful with it. However, as events progressed, the engineering manager and the production manager claimed that unforeseen problems with their other ongoing production tasks limited the efforts they could afford on Tim's project. Every time Tim asked them about progress and schedules, they replied that they were working as hard as they could and that they would be able to get more done if he and his assistant would just leave them alone. This, of course, was most frustrating to Tim, since it was *his* responsibility to see that the requirements of the contract were met and that the project was a profitable one.

The need for fuller presentation of requirements

Warren Anderson, the **engineering manager**, felt that the electronics package for the fluid drive project had not been handled well from the beginning. Initially, he had been told that there would be a minimal amount of engineering required, since the customer had already completed designs and preliminary drawings for the production prototype. However, when his group actually got into it, they found that the drawings were incomplete and that much more work would be required if the unit were to perform to contract specifications. He had requested more time for this from Tim. Tim had tried to work things out with him, but Warren felt Tim had not fully understood his problem and the limited resources available to him for this project. Thus the engineering manager felt that a lot of the present delays in his department had come about because the project manager had not understood the technical requirements for the project and had not fully communicated what was going to be required of Engineering.

Scheduling delays raise tempers.

Bill Brown, the **production manager**, was just barely getting into the project at this point. However, he was already upset with the project manager and with Engineering because he had planned to have certain pieces of equipment and workers available to start production on the 240 units in mid-March. However, the prototype packages were not yet complete as of the end of March, and it looked as though it was still going to be another couple of weeks. Bill simply had to tell Tim Davidson that Tim's project was just going to have to take its place in line, since it was not on schedule. This really upset Tim, since he thought the project was one of major priority in the firm, and yet the production manager seemed to be giving it last priority. The production manager also indicated that he would either have to keep people idle simply to work on the project when it was ready for him, which would increase the cost of production, or he would have to let people go and then rehire later, which would also increase costs because of additional training requirements.

All in all, it appeared that it was going to be a difficult spring and summer for Tim. Most frustrating was the difficulty in getting people together to work out these problems. Tim continually felt that he lacked the information necessary to complete control of the status of various activities. He also felt that because of this lack of information and control, things were likely to get worse rather than better.

Focusing Quiz

Before we move to possible resolutions of the situation at System Electronics, consider the following questions:

1. What do you think determines success for Bill Brown, the production manager, and Warren Anderson, the engineering manager?

____

____

2. What determines success for Tim Davidson, the project manager?

____

____

3. What are the causes of the problems currently affecting the fluid drive project?

____

____

____

4. What might be done to correct these problems and minimize future conflict?

____

____

____

Now, evaluate your answers against the following discussion.

A probable cause for the impasse at System Electronics

One of the probable causes of the problems at System Electronics is the difference in success criteria used by functional managers and by project managers. For example, Bill Brown, the production manager was most concerned about producing the product at minimum cost and most efficiently. Thus the timing of that production effort is probably less significant to him than the actual cost of doing it. Additionally, he is probably much more concerned with ongoing production runs than with a selected production effort on a product such as this. Similarly, Warren Anderson in the engineering department is concerned with managing his own department and scheduling his complete set of activities while keeping his people working efficiently rather than being concerned simply with this particular project. Also, since Warren was not committed earlier to the notion of having to supply a major effort for this project, he is unlikely to give it a high priority at this time. Of course, for Tim Davidson, the project manager, the success of project is the criterion against which he will be measured. Thus he is most concerned with all aspects of its completion.

Three conflicting success criteria

The need for a clear definition of responsibility and authority

One of the major difficulties in any project management area is defining the responsibility and authority of the project manager in such a way that he can effectively manage that project. Since Tim is probably less established in the company, this task is even more difficult than usual.

Relating planning and controlling

An additional problem is the jump from planning a project to actually controlling the project while it is in process. This seems to be the source of much of Tim's frustration and concern. A better job on the planning end would have made it easier to manage once this project was in process.

The requirements for successfully completing the planning aspects of a project are usually quite different than the requirements for controlling and implementing that plan. Most managers have a fairly consistent approach to any task – if you like, this approach can be called "management style" or that part of a manager's personality used in managing. In the initial or planning stages of a project, a supportive, cooperative style is generally necessary in order to secure everyone's cooperation in a poorly defined, rather fluid, situation. Later, when plans are completed, designs frozen, and production is underway, a more directive, businesslike style is needed to meet specific time-cost restraints. It is very difficult to change one's "management style" to fit the needs of the situation, but in project management, it's a necessity. A successful "style" at the beginning phases can be a liability in production if it is unchanged.

For more information, see A Theory of Leadership Effectiveness, *Fred E. Fiedler, McGraw-Hill, 1967.*

Your Dry-Run Project

The preceding case study and discussion should have given you a feeling for what project management is. Take another step toward a definition of this concept – the focus of our course – as you answer the following

Please answer these questions carefully. They provide a basis for the dry-run project you will work on through Chapter 5.

questions, which will help you relate project management to your own work situation.

1. Briefly list the more significant projects and activities you have managed to date.

2. List any broader managerial responsibilities that you feel these achievements might lead to. (Include any new assignment you have been asked to undertake.)

3. In your answer to question 2, check off those projects or activities that are too unique to be handled through any of your company's standard procedures. List here any new skills you feel you would have to master in order to successfully manage projects and activities such as these.

Now that we have arrived at a partial definition of project management, let's attempt a more precise description of the responsibilities and qualities required of a project manager.

The project manager as generalist

In fields of work other than industry, you must be a generalist before you can specialize. Thus a physician must qualify as a general practitioner before he can become a neurosurgeon. It does not work quite that way in industry. In industry you are first a specialist and then a generalist. In many instances the transition is unnerving to the new manager, even if he is entering an environment and an organization that existed before he came along. The transition can be even more unsettling if the new manager has the title of project manager, for he must then start off as if he were an independent entrepreneur. He has to:

Did you include any of these items in your answer to question 3 on the preceding page?

Plan what to do and when to do it

Recruit his own team

Quote the job

Design it

Make it

Deliver it

Dissolve his organization

Project management and survival

To survive, the specialist-turned-manager must become familiar with all his project disciplines, their interaction and their control. He may have to communicate with lawyers, accountants, machinists, quality specialists, engineers, assemblers, and a host of others, some higher, some lower, and some on the same corporate level as he. He must be able to plan and effectively control his operations. He must be able to recognize errors and cope with the necessary corrections to minimize them. This all must be done with very few corporate guidelines, for the project is as new to the company as the manager is to the project.

The central importance of the plan

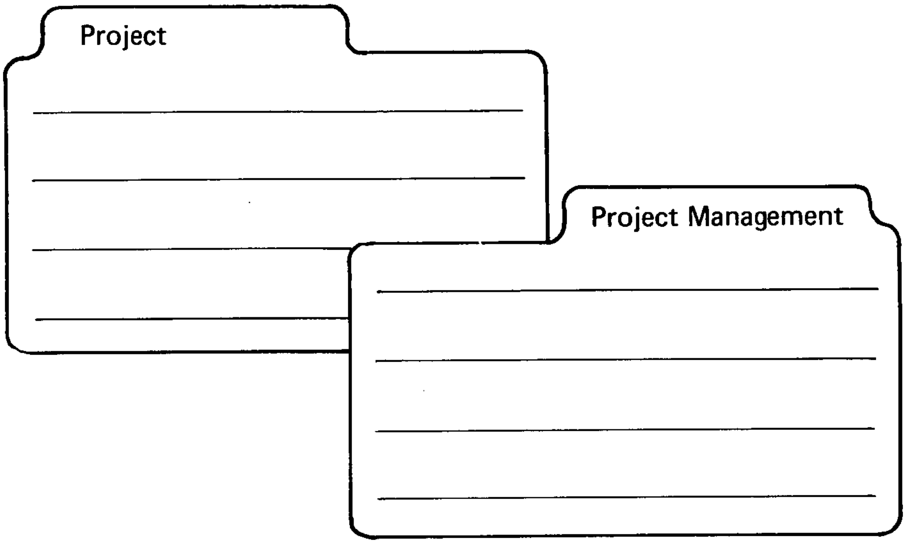
Central to the activities of a project manager is his plan. By setting up a specific and practical plan, he can provide himself with a convenient measure of progress. Without the application of such a plan, the unusual things that will invariably happen will not be recognized as out-of-plan conditions and evaluated as such. At that point, all the orders and counterorders he gives and all the overtime he assigns may not be enough to fix what should have been done right the first time.

This is not to say that all will run smoothly if you as a project manager follow the suggestions made in this course. You will have many problems as a manager, but that is why you are there. By outlining some of these problems, however, we hope to show you ways to avoid many of them – without too much sweat and pain. In any event, you will learn that you are not alone. The rocky road of project management has been successfully traveled many times before.

Key Terms

On the basis of what you have read so far, you probably have a good idea of what project management is. Write definitions of the two key terms below.

Check your definitions against those at the bottom of the page.



When Project Management Is Best Used

There was (and to some extent still is) a rather sharp division between functional management and project management. In the past, this division was primarily due to increased size, complexity, and other customer needs. Recently, the tendency to allow less time for a design, development, and production cycle, in addition to a lessened tolerance for product error and repair, have led to the use of the project-

Key Terms

A *project* is an organization designed to accomplish a specific achievement. It is created from within a functioning parent organization and dissolved upon completion of that achievement.

Project management is the direction and supervision of a project. It is typified by the use of specialized control techniques.

management concept in progressively smaller and less complex systems. Missile systems, communications networks, and major manufactured components are now frequently managed by the same general organization concepts that guided the building of bridges, tunnels, and the ancient pyramids. These concepts have been coupled with advances in planning and managing theory, in order to compress the design, development, and production cycle.

Project management: then and now

The old idea of project management was to set up a separate organization to coordinate and perform the task. To many contemporary organizations, this approach is inadequate because of time-quality limitations. Seasoned and qualified personnel have to be immediately available, thus precluding the recruiting and training of a separate organization from the ground up. (Granted that the pyramid builders did their job well, but if they were forced to do the job in one tenth of the time, it is doubtful that the final product would have been complete or recognizable as a pyramid.) Recent defense needs have caused changes in project-management techniques. The customer's constantly changing requirements have led defense contractors to push "the state of the art" to give him what he wants. In effect, contracts are being predicated upon inventing a product to a schedule. The fact that groups organized under the project-management concept have succeeded in solving these complex problems has led to the wide extension of their use in diverse organizations.

> It is one thing to build a dam, but it is quite another to build a hydroelectric irrigation system of many dams, canals, and locks on a river system that occasionally changes its river bed, and to do it in the time it takes to build one dam. Here was a need for a manager and a management system that was unique. Between the extremes of the pyramid builders (the ultimate in project orientation) and most manufacturers of small products (the general rule for functional organization) is the mean of the contemporary project-management concept.

Reviewing Quiz

The preceding text is the basis for the following quiz. Circle each statement that gives a valid reason for the increased application of project management techniques in recent decades.

1. The need to compress the design, development, and production cycle

2. The need to simplify the product

3. The availability of ample time for the customer to return the product for repairs

4. The need for increased coordination of everyone concerned with the product, including vendors as part of the "team"

5. The need for products that are correctly made the first time because the products could not be repaired after the customer received them

Basic Ideas Behind Project Management

As you have discovered, project management is a complicated affair. You may find it easier to grasp after you have examined these three ideas which lie behind project management.

Basic idea 1: A manager and a project are established for a single purpose.

Basic idea 2: Management planning systems and information flow can be realistic, foresighted, and prompt enough to allow an equally prompt and corrective input.

Basic idea 3: The organization set up for the project exists as a separate task entity with the parent organization but does not exist administratively.

The personnel staffing the project do not report directly to the project manager on any matter not directly concerned with their project tasks. They have their own functional managers for administration. For example, in an industrial situation the production manager reports to the project manager concerning project components being manufactured in his shop but reports to the general manager about such matters as personnel problems and shop supplies.

Incident

Colten Publishing Company: comparing functions and project management modes

Consider what you have read so far as you examine the following incident.

The Colten Publishing Company had recently been reviewing its organization for handling the development of new books. Traditionally,

Reviewing Quiz

You should have circled items 1, 4, and 5.

the company had published books in the textbook area, as well as in the professional field.

In the textbook area, the company had been organized along functional lines, with a manager of editorial services, a manager of production, and a manager of promotion. The process for developing a new textbook involved, first, turning it over to the Editorial Department, which worked with the author to obtain a completed manuscript. The manuscript would then be turned over to the Production Department, which handled the typesetting and printing, sending the material back to the author for a final reading of page-proofs. Once the book was actually bound, it would go to the Promotion Department for the development of a marketing plan. The company had found this organization to work fairly well, except that it seemed to take much longer than necessary to complete each new title.

Because of the need to get titles out rapidly in the professional market, that portion of Colten Publishers had both a functional organization (somewhat similar to that on the textbook side) but also used project managers. The project manager for a new title would work with the author, with the appropriate Colten editor, with Production and with Marketing, in order to develop a plan and timetable for completing the entire project. It was then the project manager's responsibility to coordinate the efforts among the functional group and to see that the projects were completed on time.

1. What do you see as the advantages and disadvantages of each of these organizational structures?

2. What do you see as the possible conflicts of each?

Throughout this course, responses to the Incidents appear at the bottom of the page.

3. Do you think they should alter the organizational structure in either the textbook area or the professional book area? Why?

Rules of Conduct for the Project Manager

Now you know what project management is. Does it create any special problems from a manager's point of view? This is a question we will be answering throughout the course. The following two rules of conduct form the basis of that answer.

Rule 1: Do not do it yourself.

A project manager should not run a lathe; he should not design the product, or develop the tooling, or assemble parts. He should manage the effort that brings together the proper ingredients of materials, skills, and equipment at the right time and place at an optimum cost. If he feels that he must write paragraphs of a contract, he may have failed to convey his wishes or to train his contracts people. When the project manager's people, material,

Incident

The basis on which functional versus project management structures should be compared depends on the goals and objectives of the task at hand. For example, in the Colten Publishing situation, there are several criteria that might be given different weights, depending on whether the project is a textbook or a professional book. These criteria might include such items as speed (time from start to finish in producing a new book), cost, quality, and product definition. The project management approach would tend to be somewhat faster in getting the book onto the market, could probably lead to somewhat higher, better product definition, since all of the different inputs to the book would be coordinated more closely. On the other hand, a functional organization might result in somewhat higher quality since each phase would be handled by those most knowledgeable about it and might also result in somewhat lower cost because the overhead of project management would not exist. The decision as to which would be most effective depends on the goals for that particular activity or project, and there should be some management system set up to weight the desirability of each goal. With an agreed-upon weighting system (it need not be objective if all concerned agree upon the system), it should be possible to more easily quantify any decision and review it later if the situation changes.

This second rule is dealt with more fully in Chapter 3.

These two rules are seemingly simple to understand, but quite difficult to follow.

and environment are arranged in the most profitable manner, he can then proceed to get the job done on time, for the right price, through guiding the efforts of others.

Rule 2: Organize your resources to fit the project. Build in prompt and exact intraprogram data flow.

The project manager should make certain that everybody knows where he is in the project, what he is to do, and when his task is to be completed. The how-to-do-it can generally be delegated.

When applying the first rule, the temptation to "show them how it should be done" is great. If your training was in engineering, you might be tempted to assist, unasked, in design. This is also true for other disciplines, such as accounting and sales. There may be an occasional need to do this, but this need should be only in an extreme emergency when there is absolutely no one else to do it or no one else, at the moment, who can do it. The project manager's job is to coordinate, direct and expedite: in other words – to manage – to amplify his efforts through others.

Incident

Kathy Jones: a challenging project runs into some typical difficulties.

Consider these rules of conduct as you read the following incident.

It was late in the day on Saturday at the end of an 80-hour week and Kathy Jones was about ready to throw in the towel. She had been working day and night for three weeks trying to complete the plan for moving the Acme Insurance Company offices from downtown to a new building in one of the suburbs. Several weeks before, her boss had asked her to set up a project team to plan and oversee the move to the new facilities. At first she had thought that the assignment would be challenging and rewarding. However, it had turned out to be a real nightmare.

Since she had worked for a moving company as a dispatcher, Kathy had previous experience in handling the logistics of such moves. She seemed like a "natural" to take over this project for the insurance office. However, she found herself doing more and more of the work in planning the move and actually supervising individual parts of it. She also found that not all the anticipated support was available when she actually needed it. In some sense, she thought she had probably underestimated what was required for successfully completing the project. Now it was almost over and she figured she could hold on for another three or four days, when everything would be out of the old offices and into the new one. However, she wanted to review where she had gone astray so if she ever got involved in another project like this she would not make the same mistakes.

What do you see as Kathy's main problems?

Summary of Chapter 1

Project management is the directing and controlling of a relatively short-term project or systems-oriented organization with functional personnel assigned as required and established for the completion of specific goals. As a project manager, you will be responsible for supervising personnel efforts efficiently. To do this, you must organize your assets and establish an efficient data handling control system in order to provide information upon which management personnel can make decisions.

Historically, as the complexity of an effort grows, it progresses from functional management to project management and finally to an administratively separate task-oriented organization. In this course, we are concerned with a more contemporary application of the project-management concept: one based on "two-headed" control, in which the task responsibilities are the project manager's but the administrative responsibilities belong to the functional manager.

Incident

Cathy's main problem would seem to be that she has tried to undertake too much of the actual activity in this project, due largely to her background and familiarity with other similar projects. This is a frequent mistake of project managers. They simply underestimate the resources required and assume that they themselves can fill in and perform those tasks when no one else is available. A much better guide for handling such projects is to limit oneself to managing the project and making sure that all costs are adequately handled by others assigned to help.

Chapter 1 Progress Check

Fill in the missing word or words.

1. A ______________________ is an organization that is created from within a functioning parent organization, solely to achieve a specific goal.

2. Larger and more intricate activities are more commonly handled through ______________________ management.

3. In recent years, customer needs that allow less time for a design, development, and production cycle, in addition to a lessened tolerance for product error and repair, have led to the application of the ______________________ concept in progressively smaller and less complex systems.

Indicate true (T) or false (F).

4. In industry, as in the field of medicine, you have to be a generalist before you can be a specialist. ____

5. Project management, which is the direction and supervision of a project, is typified by the use of specialized control techniques. ____

6. The project exists as a separate task entity within the organization, but it does not exist administratively. ____

7. Projects should be intentionally set up in such a way that problems can be forecast and solved before they become major stumbling blocks. ____

Circle the letter before the correct answer.

8. The project manager's job may include

   a. planning what to do and when to do it

   b. dissolving his organization

   c. both of the above

   d. neither of the above

9. In a functional management system,

   a. personnel serving one function, such as sales, seldom have much professional interaction with personnel serving another function, such as production.

   b. design, development, production, testing, and delivery do not normally overlap in time.

   c. both of the above

   d. neither of the above

10. The project manager should

   a. make sure everyone knows what he is to do on the project

   b. make sure everyone knows how he is to perform his tasks

   c. both of the above

   d. neither of the above

Answer briefly.

11. For what kinds of projects might project management be more appropriate than functional management? ______________________________

____

____

____

____

12. For what kinds of projects might functional management be more appropriate than project management? ______________________________

____

____

____

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13. What are three basic ideas behind the contemporary application of the concept of project management?

14. What are two basic rules of conduct for project managers?

15. Comment on this statement: "How am I supposed to be a project manager all of a sudden? I've been an engineer all my working career."

Answers to Chapter 1 Progress Check

1. project

2. project

3. project management

4. F 5. T 6. T 7. T

8. c 9. c 10. a

11. Historically, any large and complex operation that involved tremendous inputs of capital and labor was produced through what amounted to project management. Today, products that must be designed, developed, and produced in a short time and with little tolerance for error are produced through project management, even though some of these products are relatively small and not complex.

12. Functional management works well for operations that are relatively small and uncomplicated, needing no more than cursory supervision. The customer for functionally managed products generally has the time to wait for a normal sequential process of design, development, production, testing, and delivery. He should also have the time to send the product back for repairs if it fails to operate upon delivery.

13. Three basic ideas behind contemporary project management are:
    a. A manager and a project are established for a single purpose.
    b. Management planning systems and information flow can be realistic, foresighted, and prompt enough to allow an equally prompt and corrective input.
    c. The project exists as a separate task entity within the parent organization, but does not exist administratively.

14. Two basic rules of conduct for project managers are:
    a. Do not do it yourself.
    b. Organize your resources to fit the project. Build in prompt and exact intraprogram data flow upon which decisions will be based.

15. This is a common situation for new managers fo find themselves in; it is normal to have been a specialist before becoming a generalist. The speaker may take heart in knowing that others have made the transition before him. Also, he may work hard to set up a specific and practical plan for his project. This plan will be a convenient measure of his project's progress.

2 PROJECT MANAGEMENT

Organization

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2 ORGANIZATION

Learning Objectives

After finishing this chapter, you should be able to:

- Define authority, responsibility, and accountability.
- Describe the ideal flow of power within an organization, as well as factors that modify this ideal flow.
- Outline a plan for a project-management system, basing it on the four system life-cycle phases.
- Select appropriate personnel for that system.

Power Flow in Project Management

Key Terms

Authority

The power to make final decisions that others are required to follow.

Responsibilty

The obligation, which results from a person's formal role in an organization, to perform assigned tasks effectively.

Accountability

The fact of being answerable for the satisfactory completion of specified tasks.

Focusing Quiz

In each space in the paragraph below, fill in the word "authority," "responsibility," or "accountability."

A foreman has the power, or (1)________________________, to determine how much raw material he feels is needed.

He has the (2)________________ to ensure that there is always sufficient raw material to keep his machines running. Therefore, he has (3)________________ to the production superintendent for the efficient use of that raw material.

Incident

Jim Ray: developing a new product creates a conflict between project management and functional management.

Consider the meanings of the terms authority, responsibility, and accountability as you read the following incident.

Jim Ray had only recently been assigned from the Engineering Department to the Project Management Department in order to work on one of the company's new products. This new product was really second-generation to a product that had been produced for the past three years. However, recent shifts in consumer preferences had led the company to make changes in the product in order to improve its marketability. The Project group had been assigned the responsibility for seeing that the necessary changes, identified by the Marketing Department, were incorporated by Production into the new model. Since Jim had worked a couple of years previously on part of the development of the product, it seemed natural for him to be assigned to the project manager responsible for completing the new model.

A new project manager may have trouble getting heard.

The project manager had assigned Jim the responsibility for getting the bugs out of the production process so that the new model could be produced economically and in sufficient quantity to meet market demand. At the present time, Jim was feeling particularly frustrated because he had outlined to the Production people several suggestions which he thought would improve the economics and increase the rate of output. However, he had been unsuccessful at getting them to really try these suggestions. Production simply seemed too busy turning out other products to worry about this one. While they were turning out some units of the new model, they were not producing the quantities that the project manager considered desirable.

What is the major source of Jim's problem?

____

____

____

____

A response to this Incident appears at the bottom of the next page.

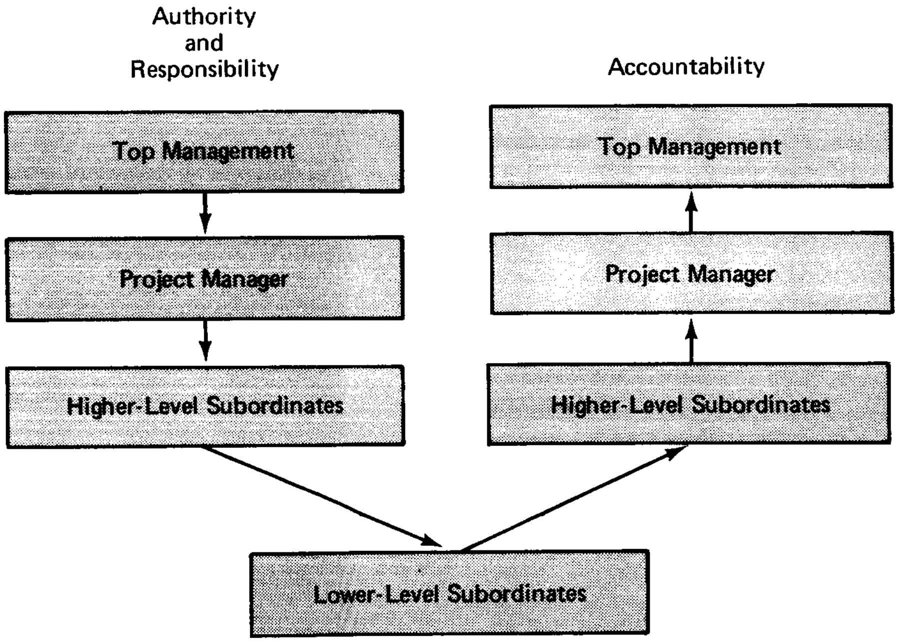
Focusing Quiz 1. authority 2. responsibility 3. accountability

Delegation and abdication

As the incident you just read demonstrated, management starts with a delegation of responsibility. With it generally goes the authority to get the job done. This authority may be directed or implied. Accountability, however, cannot be delegated downward. For example, the president of a company is responsible for the entire direction of the organization, and he is accountable to the board of dirctors for the efficient discharge of this responsibility. He can delegate the day to day responsibility for company operations to the company general manager and can direct that the authority for expanding or contracting the work force or expending funds also be given to the general manager. But he cannot delegate his own accountability for company profits. The president holds the general manager accountable to him, and he in turn is accountable to the board of directors, who are accountable to the stockholders. Occasional attempts to delegate accountability result in management's abdication – not delegation.

Figure 1

The ideal flow of authority, responsibility, and accountability



Incident

The major source of Jim's problem is the inappropriate balance between authority, responsibility and accountability. Jim's supervisor, the project manager, is clearly responsible and accountable for completing the project and achieving its objectives. He has delegated some of this responsibility to Jim on Jim's part of the task. Unfortunately, the Production Department has a different set of objectives. Their authority and responsibility is that of a functional manager, and thus they have the ultimate authority over what they do and do not do. This makes it particularly difficult for Jim since he must work through those people and convince them that it is appropriate to follow his directions and try his ideas in order to work towards the successful completion of this project.

Theoretically, then, authority and responsibility are coupled together in their initial travels downward, whereas accountability usually travels upward alone. Actually this flow does not occur as theoretically predicted. Individuals and organizations affect the flow in accordance with their own ideas and intentions. A successful manager, recognizing this, will attempt to optimize his own position.

Focusing Quiz

You have just read how project authority is delegated. How do you think it might be exercised? Check the box before each statement that gives a valid condition for a project manager's effective exercise of authority.

☐ 1. The authority has been assigned to him.

☐ 2. He has a reputation for making sound decisions.

☐ 3. His subordinates are aware that he knows how to use muscle when necessary.

☐ 4. He knows he will be backed up by the authority of those above him.

☐ 5. He has a solid grasp of the overall program.

The implications of project management as official policy

Here is an example of the exercise of authority: Suppose that the top management of an organization is aware of the tremendous benefits resulting from a project management type of operation and has stated as a matter of organization policy that project managers are here to stay. The appointment of a project manager becomes a directed delegation of responsibility and authority and occurs when the complexity and size of the task to be accomplished are large enough to fix the accountability for successful completion on one person. Either an informal memo is sent out, or a formal publication is made of the project manager's appointment to the position, or both.

Authority: potential and actual

Practically speaking, this means very little to you as the newly appointed manager. Although success as a big game hunter cannot be achieved legally without a hunting license, no hunter deludes himself into thinking that the issuance of the license means anything more than the legal right to try to succeed. Even though a piece of paper says that you have the authority to manage, it does not mean that you will manage. Before you will really have authority, you will have to:

- Assume authority

Focusing Quiz — You should have checked all the boxes. The text that follows should make clear why.

- Exercise authority
- Be backed up by authority

The idea of exercising authority – which includes using a little "muscle" when required – will become less important as the project manager gets more authority. Because authority is based partly on the particular manager's reputation for sound and consistently correct decisions, that reputation should be a major goal. In turn, consistently correct decisions are partly dependent on the manager's correct assignment of priorities to specific problems. Knowing the over-all project or system life-cycle phases will assist him in these priority assignments.

The task or project that you are to manage can be anything. It can be the renovation of the locker room, or it can be the construction of a complete defense system. Both projects can offer complex problems of varying magnitude. These problems must be solved if we are to satisfy the need that caused the project to be established.

In the case of the locker room, the need became evident when the company's work force was increased by 50 per cent. The parameters of the need are obvious. As another example, let us assume the problem involves design, development, qualification, production, delivery, logistics, and quality of a flight control system under the project management concept. The project exists because there is a need for a control system to put a missile in flight.

System Life-Cycle Phases

For a more detailed discussion of these phases, see AFSCM 375-3, Systems Management Manual, *June 15, 1964, AFSC, USAF, p. 37.*

We will now turn from the flow of power within and beyond a project to another theme: the phases of a project. The connection between these two themes will not be apparent now. However, you will discover it later in the course: the way in which a project manager should exercise his authority varies from phase to phase.

There are generally four phases to a project system life-cycle. Although we treat them as sequential activities, they may not necessarily occur or be planned to occur sequentially. They may (and in some cases should) occur concurrently. These phases are: conception, definition, acquisition, and operation.

Let us examine the conception phase first.

Key Term

Conception

That phase of project management in which a general picture is formed about how to achieve a particular goal.

Exploring and delineating

The project manager must know what he wants before he can do anything about getting it. Therefore the conception phase is one of problem exploration and delineation. In the case of the flight control system, the theoretical scientists and engineers are predominant in this phase, and it is not necessary to have any particular hardware in mind. There does, however, have to be a concept, an idea, of a system that will satisfy the need. The need in this example can be more carefully outlined in terms of the limiting requirements of the proposed solution concept that will be acceptable to the customer.

Project: Flight Control System

Limiting requirements

1. The impact at the end of 3000 miles of flight should be within one mile of the target's center.
2. The power requirement should be continuous at 30 amperes 28 volts direct current for 15 minutes.
3. It should weigh no more than 30 pounds.

As soon as possible, establish whether it is possible to satisfy the limiting requirements.

The main points to be followed are for project personnel to understand the limiting requirements and acknowledge that it is feasible to satisfy these requirements. A general functional drawing (such as an outline drawing for a mechanical system or a flow diagram for a process control) can then be generated to show the potential solution. When both the need and an idea for the solution of that need exist together, the manager is well on the track to a solution to the problem. However, it does not just happen without someone to manage it and to see that the proper solution does materialize.

Your Dry-Run Project

Now apply what you have just read about the conception phase. Pick a project you might possibly manage for your organization. (Consult the list you made on page 1-7.) In the space below, list what you know to be or feel might be the most likely limiting requirements.

Project: ____

Limiting requirements

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Key Term

A second phase of the project system

Definition

That phase of project management that includes the detailed preparation of everything needed to outline the *how* of the system.

Filling in the details

Now that the project manager knows what is wanted and some adequate ideas have been generated about how to achieve what is wanted, he is ready to define the system. In the case of the flight control system we have been discussing, definition must include the preparation of detailed drawings, specification lists, test procedures, and test equipment design. This phase can either be a tremendously expanded task involving thousands of drawings or it can be a "let's buy that from the Joe Jones Company" task. The basic test for completion of this phase is the ability of someone else or some other group to take the data that this phase has generated and produce the system from these data.

While the definition phase of the flight control system is still primarily engineering in nature, it includes contractual and legal elements. The data on the particular drawing must exactly define the product and the required test procedure must be precisely detailed. Otherwise, for example, a vendor, through no fault of his own, might send the project a product that could not satisfy system design requirements. His specification might say "a maximum of three drops leakage," when the project really wanted "a maximum of three drops leakage in three minutes."

When the definition phase is unintentionally left incomplete, unforeseen problems may occur at a later stage in the project life. As an example, a sample casting was coated with a new process that exhibited remarkable resistance to corrosion under accelerated life tests. The project engineer then specified this process on the casting drawing. The production castings, however, deteriorated under corrosion testing under normal extended life testing. After many weeks of work it was discovered that the original casting had been impregnated before the processing which assisted the process in resisting corrosion. Neither the final processor nor the engineer was aware of this impregnation before. This was simply a problem in inadequate definition.

Your Dry-Run Project

Now extend your dry-run project into the definition phase. In the following space, list the kinds of preparations (drawings, and the like) you would have made up in this phase of your project. Be as specific and complete as you can.

Key Terms

Two more phases of the project system

Acquisition

That phase of project management which covers all aspects of production and procurement.

Operation

That phase of project management during which the customer has possession of the product in sufficient quantity to satisfy his immediate needs.

Notice that different kinds of project personnel enjoy prominence at different stages of the project. We will discuss this point more fully later in the course.

Tooling, test equipment, make-or-buy decisions, capital-equipment procurement, assembly techniques, and operation sheets would all be factors to consider in the acquisition phase of the flight control system. The production and purchasing people become prominent at this point. The first systems are built and tested for qualification approval. Quantity production and delivery occur as planned, and the production line is running.

During the operational phase, the customer would need such things as handbooks to explain how the system can be repaired – detail drawings to obtain spare parts – field test equipment to check the system without sending it back to the factory – representative training for his personnel to repair the system if it becomes damaged, and an entire array of supplemental data and information, depending upon product complexity.

Reviewing Quiz

Now review what you have just read about the four phases by completing the following quiz, which applies to the project management of the flight control system described in the text. Draw lines to connect each sentence begun in a white box with the correct ending or endings in the shaded boxes. (In some cases, there may be more than one right ending. Some endings may complete more than one sentence.)

1. For the project manager of the flight control system, one of the end results of the conception phase should be

2. Among the end results of the definition phase should be

3. Among the end results of the operations phase should be

A. Test equipment design

B. Finished drawings

C. A general functional drawing

D. A repair manual

E. Completed Systems

4. In the conception phase of the flight-control-system project,

5. In the definition phase,

6. In the acquisitions phase,

A
The efforts of the legal department would predominate

B
The efforts of the production and purchasing departments would predominate

C
The efforts of the repair staff would predominate

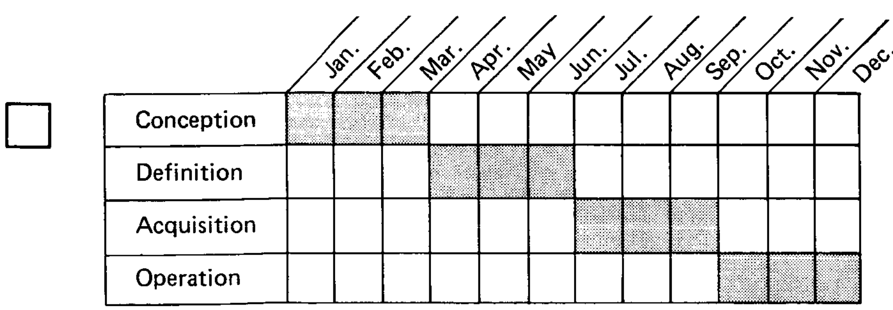
D
The efforts of the engineers would predominate

E
The efforts of the public relations would predominate

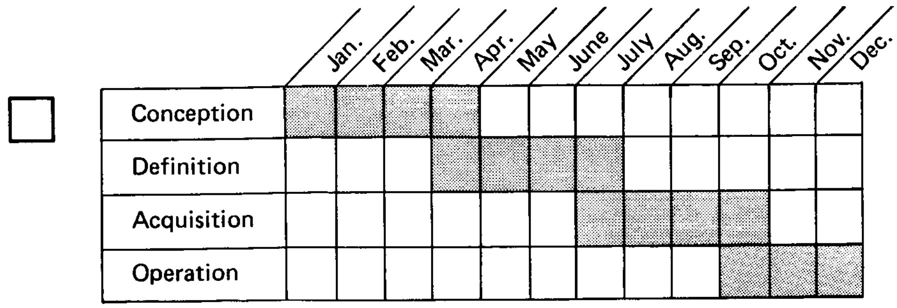
Timing and Systems Life-Cycle Phases

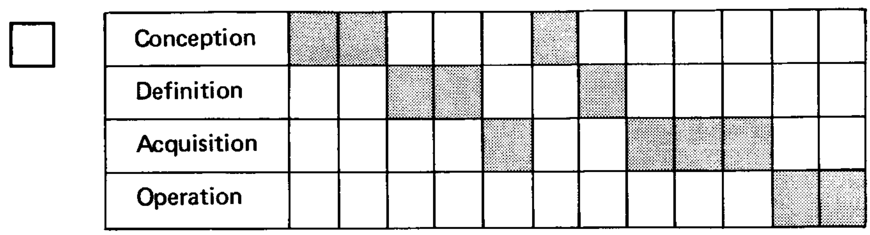
Focusing Quiz

When does one phase of a project-management system start and another stop? In practice, do the phases overlap? Examine the following charts carefully. Then, on the basis of what you have read and thought so far, check the box in front of each chart that shows what you feel might be a possible timing and sequence of the phases.



Reviewing Quiz 1. C 2. A, B 3. E 4. D 5. D 6. B





Being flexible

There is no clear point in time when one phase starts and another stops. Who is to state that the definition phase is over next Tuesday at 10 a.m. and the acquisition phase begins at 10:01 a.m.? The phase-in and phase-out procedures are quite vague, and it is not unusual to find all four phases in continuous and simultaneous existence from project beginning to end. It is quite possible during the operational phase, for example, to discover an additional characteristic needed in the system and to plunge right back into the conception stage to get the characteristic incorporated into the design. Take the case of mud being splattered all over the control system when a missile is transported in the field. The project manager wants to keep this mud out of exposed bearings – an objective which will call for going back to the drawing board for design modification. This may involve a simple rubber cover or an entirely new missile carrier. He has returned, for redesign purposes, to the definition phase.

The necessity for outlining the four phases becomes obvious when you try to visualize your entire project. You must understand the mechanics of the entire system to manage it. The planning or visualization which you must do to manage it becomes easier if you can break the job into fairly small sections.

Focusing Quiz

You should have checked the boxes in front of all three charts. The text that follows clarifies why.

Avoiding and evaluating problems

The manager's major asset is his use of time. To use time best, he must eliminate or solve problems before they develop and hold up the project. Then he must visualize the degree of importance of a problem to the project before spending time on it. When there is a choice between improving the shipping container so that it is easily stacked in a truck, or increasing the strength of a shaft in the control system so that it will not break under load, the system life-cycle phases shout: "Solve the shaft problem today – tomorrow is all right to resolve the container problem." The shaft problem is in the definition phase while the container problem is in the acquisition phase.

The Right Personnel for Project Management

Focusing Quiz

The preceding discussion suggests that project management requires the manager and his personnel to be more flexible – which is to say, less specialized – than they would need to be in a functional management situation.

1. Why do you think this is so?

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2. Given the need for flexibility, would you, as project manager, want to deal with as many people as possible, or as few? Why?

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Check your answers in the following text.

Broad-spectrum specialists versus limited specialists

The personnel the project manager selects to manage various portions of his project should if possible be broad-spectrum specialists. As an example, the quality control manager will be an integral member of all four phases, from project beginning to end. (One does not correct quality deficiencies; one designs and builds them out.) He will be involved in design, qualification, production, service, procurement, and, if the project manager is lucky, he will even diplomatically tell him what he is doing wrong in managing the project. He must be a quality-control man first, but second he must be aware of, sympathetic to, and assist in production scheduling, vendor delivery delays, and customer contractual documentation needs in areas not directly associated with quality.

Answer to question 1

This means he must be flexible – a most important characteristic for every project and section manager. (A *section manager* is one who is responsible for a section of the project. The project engineer and the contracts administrator are two examples.) Unless the project is very large, the project manager cannot afford the luxury of the limited specialist as a section manager. Section managers may not have to wear many hats. But if they do not understand and are not prepared to assist the man wearing the next hat, the project manager will either be spending all his time doing the work of one section manager or another or arbitrating between them. He has too much to do as it is without wasting time, his main asset.

Answer to question 2

The solution to the talent problem, then, is not easy. The project manager can minimize this problem by selecting the best possible people and also by attempting to minimize the number of people reporting to him. He should eliminate those positions that he can fill himself (being careful not to fall into the do-it-yourself problem) and consolidate part-time positions into fewer full-time ones. (For example, if you are the project manager and have a background in accounting, it might be wise to handle the finance slot yourself.) A potential consolidation might be production and procurement. This consolidation is eminently desirable not only from a talent selection viewpoint but also from an economic viewpoint, for it tends to decrease the costs of managing.

Your Dry-Run Project

Can you apply these principles of talent selection to your dry-run project? List people you know in your organization whom you feel qualify as broad-spectrum specialists now, or could qualify if given an opportunity.

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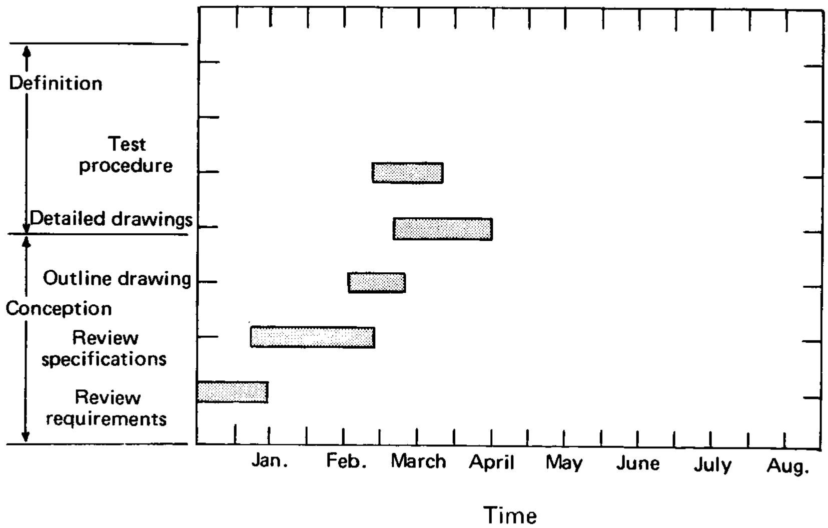
Development of First Plans for a Project

Let us now put aside our discussion of who does the work, and ask what work it is these people might be doing. It is time to start developing project plans. The project manager's first plans should cover the four phases. Because he lacks finalized requirements, these plans are general in nature and may be limited to a time and personnel requirement. The customer (or the need) has given him an idea of what and when. At this point a useful planning device is a Gantt chart which consists of a listing of tasks as the ordinate versus the project time as the abscissa.

Figure 2

Gantt chart of conception and definition phases



Your Dry-Run Project

Please complete this exercise carefully. It offers you a good opportunity to practice the kind of first-stage thinking that is required of a project manager.

Now apply what you have read to your Dry-Run Project. On the top line of the following form, fill in the project you selected on page 9. On the succeeding lines, make a tentative list of what you feel are the major tasks involved in this project.

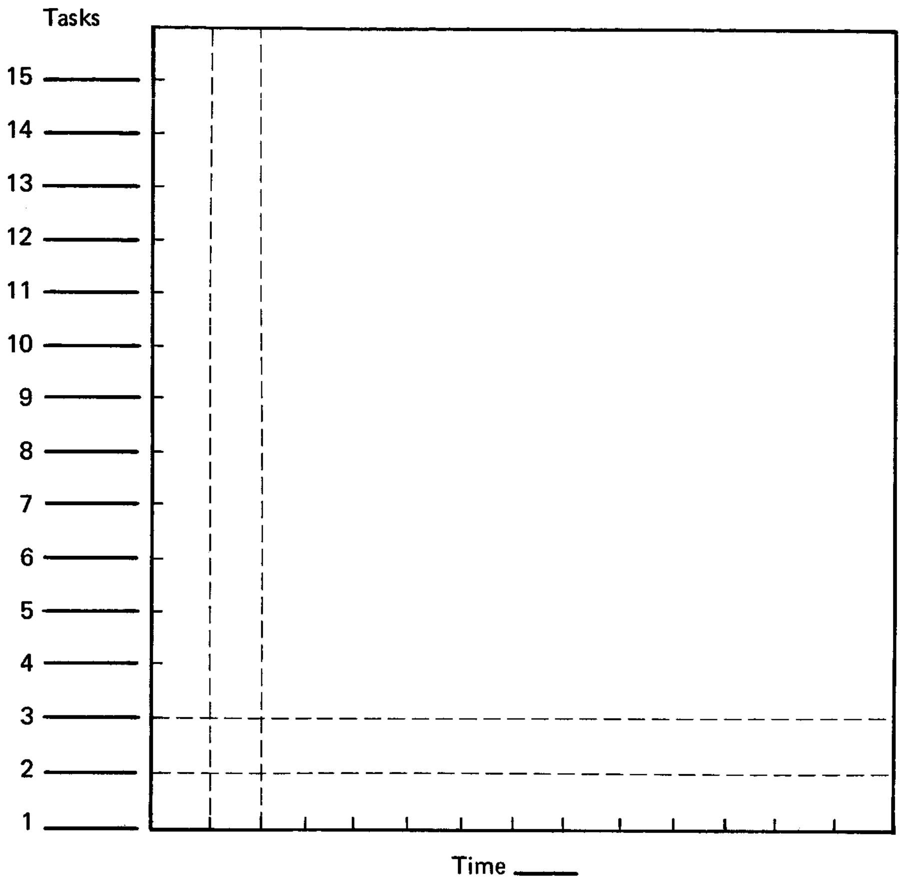
Project to Be Managed: ______________________

Task Breakdown

In the boxes on the left, number the tasks to indicate the sequence in which they should be done. In the boxes on the right, fill in the time you feel each task ought to take.

With this information, fill in the Gantt chart that follows. For the sake of simplicity, fill in only those tasks that belong to the conception and definition phases.

You may wish to model your Gantt chart after Figure 2.



Indicate whether the time is in days, weeks, or months.

The Gantt chart will be altered and revised, for the project will be staffed by section managers who are skilled in particular areas. They will be able to refine the Gantt charts in regard to their own specific project areas of supervision. They will be able to estimate manpower needs. For example, the "Review requirements" in the conception phase of Figure 2 is scheduled through January. If the section manager estimates this review to take 320 hours, he will need two men, since there are only 160 working hours in the month. Eventually the chart may be superseded by more sophisticated planning devices, such as program evaluation review technique (PERT) charts, line of balance (LOB) charts, or specific milestone charts.(The choice will depend upon

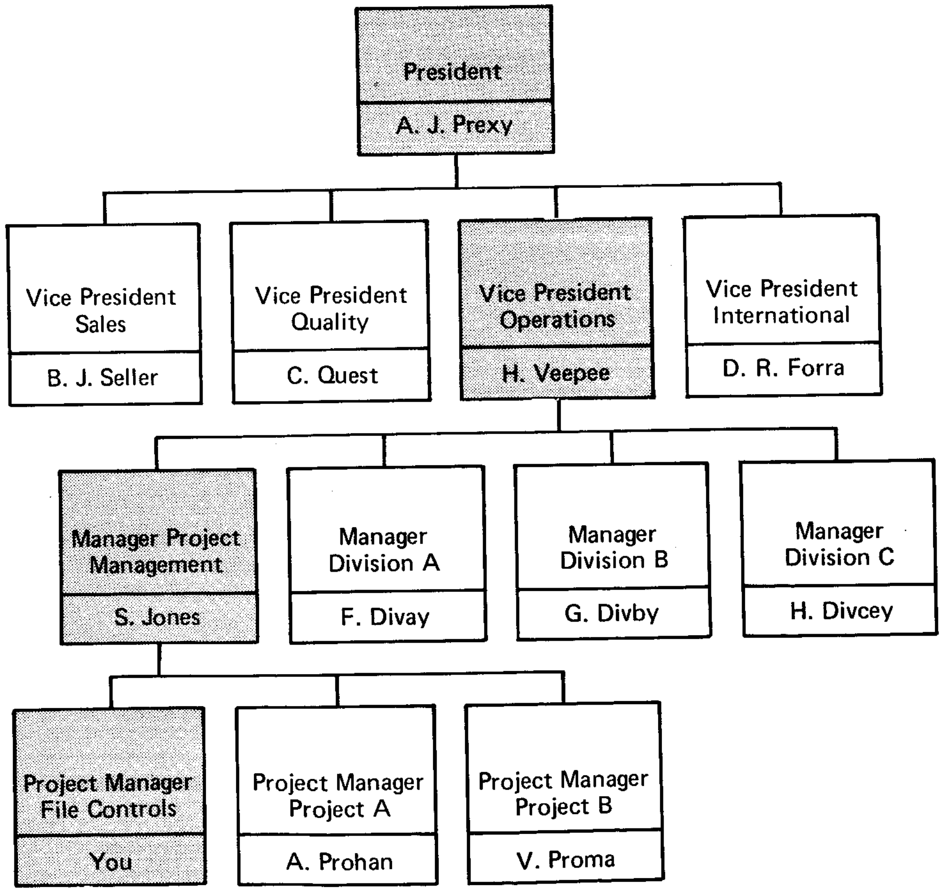
These planning devices are presented more fully in Chapter 3.

the complexity of the tasks.) At this time, however, it serves as a rough plan. If the task is straightforward, it can serve as a permanent tool, but for now the project manager can use it as a guide to the personnel skills he will need.

In the conception phase, the task descriptions in Figure 2 call for engineering, quality, procurement, legal, and sales contracts talents. The definition, acquisition, and operational phases require, in addition to these, other talents. In order to determine what these talents should be, the manager can draw his program organization chart, being quite careful to minimize the number of positions and maximize the responsibilities of each job. (See Figure 4.) The manager should plan for positions, but plan thin. There are job titles and appropriate spaces for names on the chart. To be effective the project chart must be tied into the permanent authority structure of the organization by a direct line. In our example of the flight-control-system, we will assume that top management backs project management, and we will show the organization chart with the project accountability flow right up to the president.

Figure 3

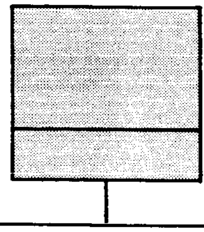
Company organization chart. The shaded boxes show the line of authority from the flight-control-system project manager to the president.



Your Dry-Run Project

Personalities are always factors in project management. Can you anticipate ways in which those above you in the accountability flow might influence the way in which you might administer your project?

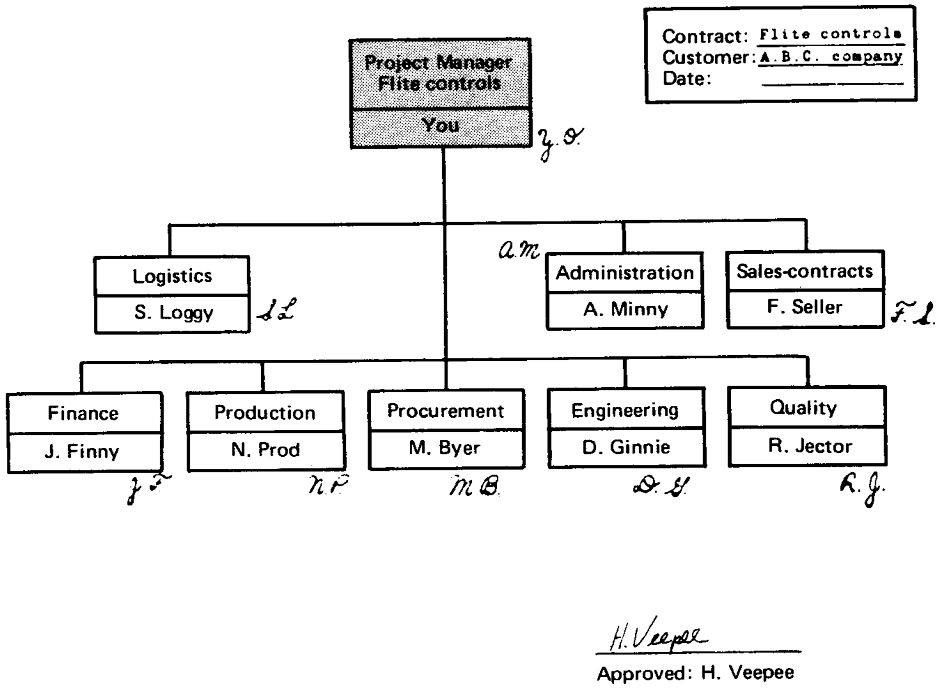
In the space provided, draw up your own organization's chart. Include all key positions from the head of the organization down to the position you hold or would hold if you were to manage the project you are considering in this course.



The project organization chart following is not descriptive of every type of project organization. A project in the food industry would probably have more emphasis and staff in marketing, advertising, and packaging, with very little need for logistics or sales contracts. The organization should be tailored for the specific project needs. The degree of organization complexity is dependent on project complexity. Regardless of the format of the project organization chart, now is the time for its establishment in the project life cycle.

Figure 4

Project organization chart



Your Dry-Run Project

This exercise will help you prepare to make up an organization chart for your own project.

In this column, list the tasks from page 18, making any needed revisions. Organize the tasks by function; put all finance tasks together, for example. Then draw a box around each functional group.	In this column, across from each boxed group of tasks, write an appropriate title for the section manager who would administer those tasks.	Leave this column blank at this time.

Review Figure 4 before preparing your project organization chart.

Now, on the form below, draw up your own project organization chart. Do not fill in the names of specific personnel at this time.

Contract: ____________________

Customer: ____________________

Date: ____________________

Project Manager

Selection of Project Personnel

The actual selection of personnel can now begin. The tools needed are available. The project manager knows what talents are required, how long they will be needed, and the nature of the project to which they will be applied. This information is vital not only for him but also for the people he will select.

Assuming that the proper mixture of personnel is available, we shall briefly cover the selection process of the systems engineer for the flight-control project. The project manager can make up a list of two or three potential candidates by

Where to look for the right personnel

- Examining personnel records
- Consulting management
- Using his own first-hand knowledge

The etiquette of the personnel hunt

His initial action is to discuss his requirements with the candidate's immediate engineering supervisor. The supervisor could tell him that his man is tied up for at least six months on another project or that the candidate is a terrific designer but cannot seem to coordinate the activities of others. Of course, it is up to the project manager to evaluate all of the information coming to him about the candidate to determine relevancy, motives, accuracy, and data environment. In any case, eventually both the project manager and John Engineer's boss agree that John is the right man. John is first informed about this opportunity in a private interview with his boss. If John exhibits some interest, he goes to see the project manager, who then interviews him. It is during this interview that the project manager uses his preliminary Gantt chart, phasing outlines, and organization chart. When both agree to the assignment, John's name is placed in the appropriate slot of the organization chart, and he initials his name as an informal contract that he understands his assignment and accepts the job responsibility.

See Figure 4.

Your Dry-Run Project

At this point, go back and fill in column 3 of your Dry-Run-Project exercise on page 23. Try to list at least three candidates for each section-manager position. Eliminate anyone you know would not be available or interested. Then select the one best name for each slot and fill it in on your project organization chart. When you have finished, read the following text.

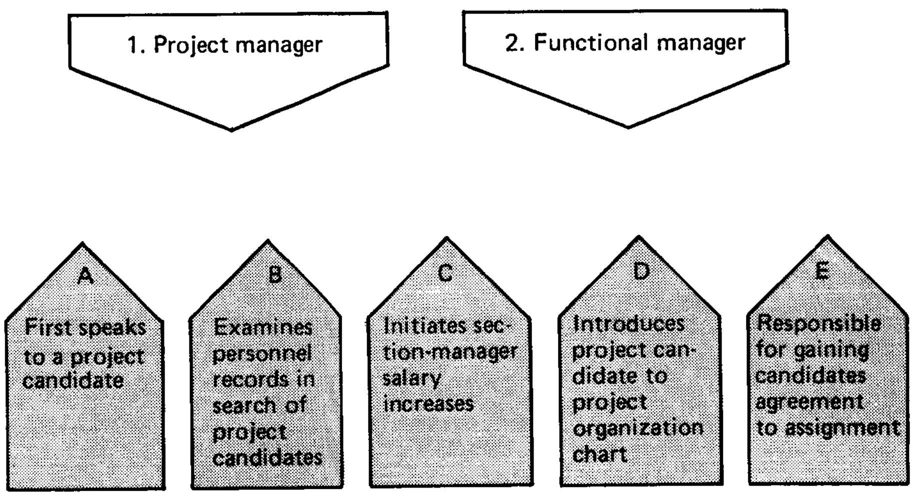
The completed chart is eventually approved by the interested officer of the organization (in the case of the flight-control system, the executive vice president-operations) and distributed to each man on the chart and his direct functional supervisor. Now the man himself, his functional boss, the project manager, and management all have agreed to the assignment. This agreement is then reproduced and distributed to all concerned both inside and outside of the organization.

This point is covered in greater detail in Chapter 5.

The project manager is now his "fearless" leader and is accountable to management for his performance respecting the project requirements. The engineering supervisor is his "spiritual" leader and is primarily accountable for John's administration. Promptness in the morning, vacation schedules, *initiation* of salary changes, and general administration are still in the functional (spiritual leader) area. Effectiveness of design, problem solving ability, general project technical support, and *approval* of salary changes are in the project (fearless leader) area. This last point of approval of salary changes (i.e., raises) is a very important one.

Reviewing Quiz

Review what you have just read. Draw lines to connect "project manager" with each of the responsibilities of that position. Do the same with "functional manager."



Incident

Romney Camera: Choosing the most effective project team

Consider what you have just read about the selection of project personnel as you examine the following incident.

As Project Manager for optics, one of the major subassemblies required for the new Romney Camera, Frank Jones needed to select one more person to work on his project team. Since the company intended to purchase all the major subassemblies, each of which required new technologies, a project team had been established to

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Reviewing Quiz 1. B, D, E 2. A, C

manage procurement of each of the three subassemblies: optics, packaging, and film.

Frank already had an engineer, whose background was mechanical engineering, on his project team and was looking for one more person to help the project team's assignment of developing an appropriate source for this particular subassembly. That source had to be able to provide the technology necessary to produce the subassembly as well as handle the actual production. One of the people Frank was considering was Sue Daniels, whose background was in purchasing. While she was young and had not worked on any project as complex as this one, she did have some experience in setting up contract agreements with vendors and in supervising ongoing purchasing relationships for established products.

The other person that Frank was considering was Steve Smith, who had extensive technical experience in some of the materials that would be involved in this subassembly. However, Steve had no background in the purchasing area and much of his technical experience was of a theoretical nature. However, Frank felt that Steve's schooling, as well as his particular interest in the process for making many of the materials going into this subassembly, might be valuable since the source of supply would have to work out of production technology. Frank's problem was trying to decide which person should be selected as the third member of the project team.

Which person would you choose and why?

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Incident

There are several factors that should be considered in selecting the third member of this project team. These include the special requirements of the project (what is most critical for the success of the project), existing capabilities on the project team, the personalities of those people being considered and their fit with the team, the personal development opportunities for those being considered, and special considerations given the environment in which the team must operate. In this case, since the new technology is involved, the most important requirement is probably being able to work closely with potential vendors and help them in developing the technology. Thus it is most likely that Steve would be the best candidate in this situation. However, additional consideration of personalities and personal development would also need to be required if such information were available.

Analysis of the First Plans

Both the generalized plans and organization now exist, and it is time to move into specific planning. This is the refinement and pinpointing of definite project objectives, with the over-all project plan as a base. Later we shall determine how the project functions (such as systems engineering, procurement, or production for manufacturing-design projects) are completed under planning and direction. In consumer goods fields, other activities such as advertising and marketing could be examined.

The detailed planning for the achievement of specific project objectives (involving a wide variation of technical skills) is susceptible to the applications of five analysis operations. Although the sequence may vary, it is useful to apply each of the following analyses against project tasks. (A task is defined here as a relatively small section of a project operation. One example of a task could be the engineering effort associated with the design of a bridge pivot. This task would be part of the systems engineering activities of a project for the design-construction of a bridge.) The five analysis operations are:

For a more thorough treatment of system specifications, see AFSCM 3753, Systems Management Manual, *June 15, 1964, AFSC, USAF, p. 4.*

1. Establish the system specifications.

Is there any ambiguity? Are there any requirements that are unnecessary to the project or that can be simplified? (This is where your project team begins to function.) Is anything missing?

2. Define interfaces and responsibilities.

For example, who is responsible for the delivery of vendor items? In some projects, it can be procurement because they issued the purchase order. But what happens if you decide to install a resident inspector in the vendor's plant and the inspector reports that he is holding up shipment because of an alleged internal procedure failure which has nothing directly to do with the hardware? Is the delivery delay an engineering responsibility because they set up the specifications or is it procurement or even quality because the inspector is holding a shipment?

In practice, as your program "seasons," you should find that titles become less important. If there is a task manager available for the job and he has some remote connection with the task, give him the ball; but be sure that you give it specifically to someone in any event. The worst thing that you can do is make no assignment at all. It will never get done then, unless you do it yourself.

3. Identify areas and degrees of risk.

Try to categorize high and low risk areas. Allow more funds and time to the higher risks. Explore potential trade-offs and alternatives. Select the best technical approaches. If the "best" doesn't work, try to be prepared with "second best"; sometimes "second best" turns out to be better than "best."

4. Establish schedules and cost estimates.

Without a standard against which to measure performance, progress cannot be measured. Admittedly, the further along you are the better the schedule and cost estimate can be. It is never too soon to establish these criteria, but until you have a fairly well defined project these criteria should always be amenable to reasonable change. As an example, suppose that initially your procurement people felt that a reasonable cost for a casting (similar to an earlier somewhat different product casting) would be $20. If you did not feel that this was a reasonable figure, you might tend not to question a final $50 quotation. You should not give in to such an inclination, however. It is entirely possible that subsequent investigation of the design specifications could reveal that the high final quote could have been avoided; such an investigation might, for example, turn up an unnecessarily costly casting painting specification which could then be revised downward. It is therefore possible for even a ball-park estimate to serve a purpose – such as to disclose an unnecessarily high cost finishing specification for a casting.

5. Formulate operational and logistic concepts.

Will spare parts be needed or will entire systems be provided as spare replacements? Is it necessary to set up facilities to train the customer in handling the product?

Operations analysis is not intended to be a documented or formal planning technique. Some of those techniques will be explored in the next chapter. It is, however, a testing tool to be used by the project or section manager; it should tell him something about the adequacy of planning at the task level. As an example, if the chief draftsman has not determined how complex the bridge pivot design will be from conversations with the engineering groups or evaluation of the applicable specifications, how can he determine how many drafting hours he will need to complete the design?

Reviewing Quiz

Check the box before each true statement about the analysis of the first project plans.

In operations analysis

☐ 1. The plan is formally documented.

☐ 2. The responsibilities of everyone on the project are established for the life of the project.

☐ 3. Any unnecessary ambiguity should be eliminated.

☐ 4. Areas of high and low risk should be identified.

☐ 5. The "how" of each project member's tasks is determined.

Incident

The Star Examiner: *coordinating and planning the installation of new equipment*

Now try your own hand at operations analysis. Examine this incident carefully and answer the question that follows it.

As the only newspaper in Hurricane, Nevada, *The Star Examiner* viewed the installation of a new printing press as a major project. In order to handle that as smoothly as possible and minimize the chances of missing any issues of the paper, the president of *The Star Examiner* had set up a project team to handle equipment installation. That project team consisted of a project manager, who had formerly been one of the production schedulers, an assistant from the Editorial Department and one of the assistants from Circulation. The company itself was organized into Editorial, Production, and Circulation functions. The project team had been given the responsibility of gathering information relating to alternative types of equipment and then presenting those to the group of functional managers.

It had then been the responsibility of the functional managers as a group to select the specific piece of equipment to be installed. The project team then was assigned the responsibility for coordinating and planning that installation. Since this equipment would replace a piece of existing equipment, it was going to be necessary to run both pieces in parallel for a short period of time to make sure that the new piece worked as planned before the old piece was removed.

With the new press scheduled to arrive within a week, the project team was particularly concerned about whether or not production would move quickly to get the new machine up and running and just what special problems might arise.

Reviewing Quiz — You should have checked boxes 3 and 4.

What were the objectives of the project team in this instance?

What would need to be accomplished for the project to be viewed as a success?

Is this the right project team to accomplish that?

Summary of Chapter 2

Theoretically, management starts with the delegation of responsibility and authority, but not of accountability. Management's downward delegation of accountability would amount to abdication of its authority.

Actually, the flow of power does not occur as theoretically predicted. Individuals affect the flow. Recognizing this, a successful manager will attempt to optimize his own position. He will admit to himself that before he will really have authority, he will have to assume authority, exercise authority, and be backed up by authority. To these

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Incident

The objectives of the project team are really to get the equipment up and running not necessarily as quickly as possible but in such a way that no issues of the newspaper are missed. This requires that all possible problems be investigated before the final commitment is made to timing the changeover. These people are probably a particularly appropriate team for looking at those kinds of problems since they know the operation of each of the areas involved. However, they will require substantial top management support and interaction if they are to foresee problems that can only be imagined based on several years of experience rather than on simply seeing the readily apparent problems.

ends, the manager should try to develop a reputation for sound and consistently correct decisions. For the project manager to develop such a reputation, he will need to know how to make the correct assignment of priorities to specific problems. Knowing the over-all project or system life-cycle phases will assist him in these priority assignments.

There are four system life-cycle phases, which may occur concurrently or sequentially. In the conception phase, a general picture is formed about how to achieve a particular goal. The definition phase includes the detailed preparation of everything needed to outline the how of the system. The acquisition phase covers all aspects of production and procurement. And the operation phase deals with that period of time during which the customer has possession of the product in sufficient quantity to satisfy his immediate needs.

Once he has been assigned to a project, the project manager's first task is to lay out his initial plans for the project with very brief descriptions of the four project phases, and from past experience to estimate how long each phase should take. He then roughly determines the type and number of section managers that he will need, and obtains the concurrence of his organization's management with his plans. He is now ready to implement them. He is aware, as is everyone else associated with the project, that these plans are tentative and will be altered by the special knowledge of the section managers that he will recruit. Insofar as possible, these section managers should be broad-spectrum, rather than limited, specialists.

Once all this has been accomplished, the project manager should then limit and refine his project plans by operations analysis.

Chapter 2 Progress Check

Fill in the missing word or words.

1. ______________________ is the power to make final decisions that others are required to follow.

2. ______________________ is the obligation, which results from a person's formal role in an organization, to perform assigned tasks effectively.

3. ______________________ is the fact of being answerable to superiors for the satisfactory completion of specified tasks.

Draw lines to connect each system life-cycle phase (on the left) with its definition (on the right).

4. Conception	a. That phase of project management that includes the detailed preparation of everything needed to outline the *how* of the system
5. Definition	b. That phase of project management during which the customer has possession of the product in sufficient quantity to satisfy his immediate needs
6. Acquisition	c. That phase of project management which covers all aspects of production and procurement
7. Operation	d. That phase of project management in which a general picture is formed about how to achieve a particular goal

Circle the letter before the correct answer.

8. In practice, the four phases of a system life-cycle can occur

   a. sequentially

   b. concurrently

   c. both of the above

   d. neither of the above

9. On an engineering project, the project manager should have particular hardware in mind by the end of the

   a. definition phase

   b. conception phase

   c. both of the above

   d. neither of the above

10. Before a project manager can really have authority, he must

    a. exercise authority

    b. be backed up by authority

    c. both of the above

    d. neither of the above

11. In seeking suitable personnel for his project, a project manager should

    a. use his own first-hand knowledge

    b. examine personnel records

    c. both of the above

    d. neither of the above

Indicate true (T) or false (F).

12. On some projects, all that is needed at the end of the conception phase is an outline of the limiting requirements of the proposed solution. ____

13. A project manager knows he has completed the definition phase when he has generated data from which someone else could produce the system. ____

14. Project management personnel should have the most specialized possible backgrounds. ____

15. Whenever possible, the project manager should consolidate part-time positions into fewer full-time ones. ____

16. First plans for a project cannot be developed until the customer has supplied finalized requirements. ____

17. Section managers should be asked to help a project manager refine his plans. ____

18. The project manager should consult a candidate directly, without going through that person's immediate supervisor. ____

19. After the generalized plans and the organization exist, it is time to move into specific planning. ____

20. It is never too soon for a project manager to establish performance standards, but until he has a fairly well defined project, these criteria should be amenable to reasonable change. ____

Answer briefly.

21. Use the terms *authority, responsibility,* and *accountability* to describe the ideal flow of power in an organization.

22. What factors modify the ideal flow of power?

23. What are four phases of a project management system, and when does each begin and end?

24. What is a Gantt chart and what function does it serve?

25. What are five steps of operations analysis?

Answers to Chapter 2 Progress Check

1. Authority

2. Responsibility

3. Accountability

4. d 5. a 6. c 7. b 8. c 9. a 10. c 11. c

12. T 13. T 14. F 15. T 16. F 17. T 18. F 19. T 20. T

21. In an ideal situation, responsibility is delegated down the line. With it generally goes the authority to get the assigned job done. This may be explicit or implied. Accountability to superiors flows up the line. Any attempt to delegate accountability results in abdication.

22. The ideal flow of power is modified by individuals in accordance with their own ideas and intentions. People operate within the system in order to optimize their own positions.

23. The conception phase begins at the beginning of the project and ends when there is a general picture of how an identified need can be satisfied. The definition phase ends when enough data has been generated so that an outside person could produce the system. The acquisition phase covers the entire production and procurement process. The operation phase covers the period during which the customer is in possession of the product in sufficient quantity to satisfy his immediate needs.

24. A Gantt chart consists of a listing of project tasks as the ordinate versus the project time as the abscissa. It is a useful device in the development of planning projects.

25. Five steps of operations analysis are:

    Establish the system specifications.

    Define interfaces and responsibilities.

    Identify areas and degrees of risk.

    Establish schedules and cost estimates.

    Formulate operational and logistic concepts.

Machinery Limited (Marketing Campaign)

A major firm in the field of industrial machinery fabrication is planning to launch a massive campaign to push the sale of a recently developed item of industrial hardware. You are asked to prepare a project plan from which schedules for the campaign preparation can be developed. You have available the information listed in the following material. The number in parentheses following the description of each activity indicates the estimated time required for its accomplishment. In general, the project may be broken down into three major categories:

1. Training of sales personnel
2. Consultation with and training of marketing personnel
3. Preparation of the necessary advertising and instruction material for the campaign

Sales

In order to save time on the sales side, it has been decided to prepare phase 1 of the training program for salesmen. (8)

At the same time, the sales managers are selecting the sales personnel who are to be trained. (2)

Both of these activities will therefore begin at the start of the project.

Following their selection, the chosen sales personnel must be relieved of their responsibilities in their areas and sent to the company's training center in the home office. (4)

Obviously it would be foolish for the salesmen to arrive before phase 1 of the training program is ready for them. When phase 1 of the program is prepared, the salesmen will be trained in this part of the program. (10)

While the salesmen are being trained in phase 1 of the program, phase 2 will be prepared. (9)

As soon as the salesmen's training in the first phase is completed and phase 2 of the program has been completed and approved,[2] sales training in the second phase can commence. The second part of the program will take (12).

At the conclusion of the two major phases of their training, the sales personnel will be issued "Customers Instruction Manuals" on the new machine and will spend a short time at the home office becoming familiar with them. (5)

---

[2] Approval cannot be given until the General Marketing Approach (see "marketing" section) has been determined.

When the salesmen are familiar with the manuals, they will return to their respective territories ready to begin their effort simultaneously with the national advertising campaign. Getting back to their territories should take (1).

Marketing

I. Personnel

The first step in the project for the marketing side will be the determination of the general marketing approach. (10)

When this has been arranged, the necessary marketing personnel will be selected (4) and brought into the home office. (2)

Following the determination of the general marketing approach, and while the marketing trainees are being selected and brought in, specific training plans for the marketing personnel will be consolidated. (2)

After these plans are consolidated, a familiarization course for these personnel will be designed. (8)

When personnel and course are ready, the training of marketing personnel will proceed. It is estimated to take (8).

II. Advertising

Immediately after the general marketing approach has been determined, advertising plans must be consolidated ("firmed up" in the jargon of the trade). (6)

When this consolidation is complete, a paper is to be *prepared,* (6) and *printed* in a professional journal. (8)

Also immediately following the consolidation of advertising plans, national advertising must be prepared (10), approved (4), and distributed to the proper media (2).

Not until the *marketing* people are trained, the professional paper published, and the advertising distributed, will the national advertising be released and carried by the media involved. The release and preparation to carry the national advertising will take about (2).

It is not planned to proceed further with the national advertising campaign until the salesmen have returned to their territories.

III. Printing

As soon as the advertising plans are consolidated (the first step under "Advertising" above), a general brochure will be drafted and approved. (4)

Following the approval of the brochure, a *layout* must be designed (5) and the brochure *printed.* (3)

As soon as the brochure is approved, a "Customer's Instruction Manual" will be prepared. (3)

The Instruction Manual in its turn must be approved (1) and printed. (2)

Copies of the Instruction Manual alone will be sent to the training center (1) where the Manual will be utilized in completing the training of the salesmen.

As soon as both the brochure and manual are printed, they will be packaged together and delivered to marketing for general distribution. The packaging and delivery together should take about (8).

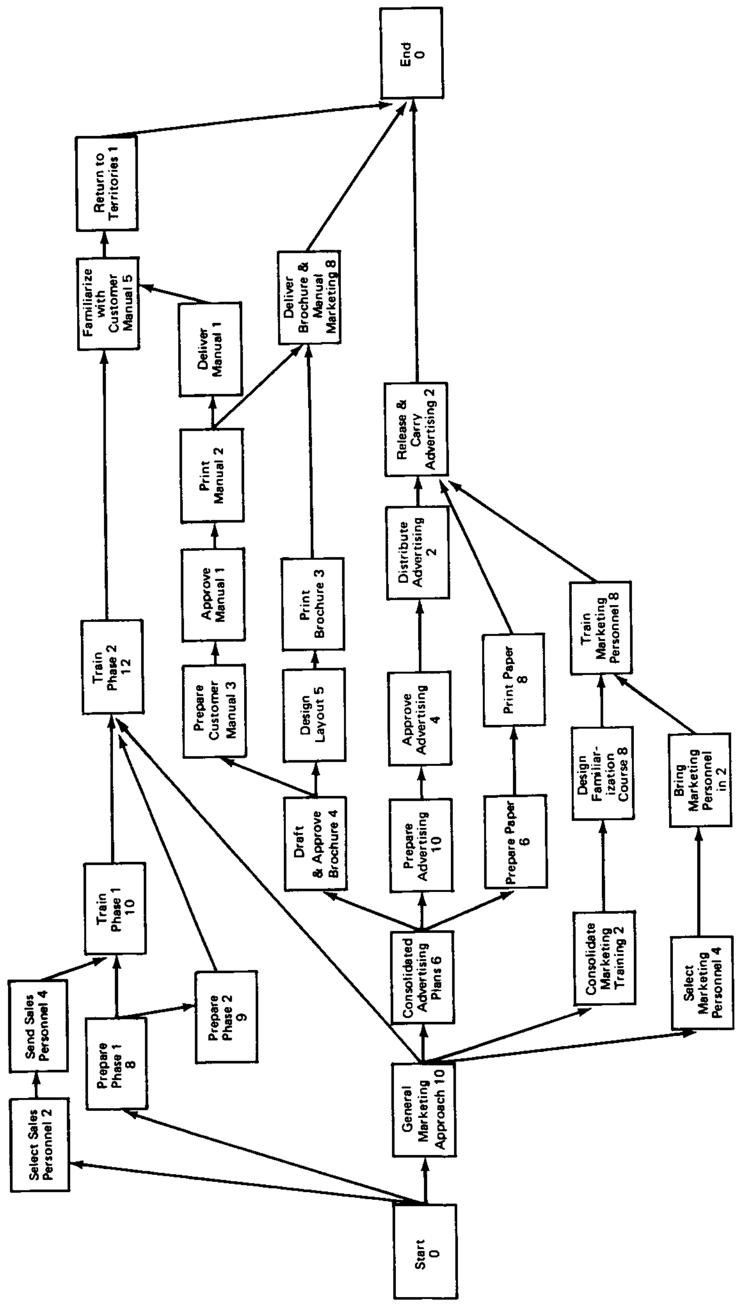
Actual implementation of the campaign (which may be regarded as the termination of this project) cannot begin until the salesmen are in their territories, the national advertising campaign released, and the proper brochures and manuals have been received by marketing.

Assignment

Review the outline for the task to be completed at Machinery, Ltd. in developing their marketing campaign. Is this the complete description of the task? What has been included that makes it so?

Machinery Limited

This description of the activities to be performed at Machinery Ltd. as part of their marketing campaign project is a fairly comprehensive one. It does three things that are particularly important. 1) It clearly defines each of the tasks that must be performed in this project. 2) It states the length of time required for the completion of each activity. 3) It provides an outline for the sequence in which those tasks must be performed.



3 PROJECT MANAGEMENT

Crisis Elimination

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3 CRISIS ELIMINATION

Learning Objectives

After finishing this chapter, you should be able to:

- Describe, in a general way, the why and when of planning.
- Draw up Gantt and milestone charts for projects of your own.
- Describe and interpret PERT, Line-of-Balance, and input-output charts.
- Explain what a project plan is and what it might include.
- Describe the need for project control documentation.

The Need for Planning Projects

Key Term

On the basis of what you have read so far, write a definition of the following key term.

Plan

____

____

____

____

See definition at the bottom of page 4.

Focusing Quiz

Circle those quotes that you feel represent sound and realistic attitudes toward planning.

1. "No matter what I'm planning, I do it down to the last detail. I don't care how long it takes."

2. "I don't expect to be able to plan this particular project down to the last unit. So I'm going to cover myself by estimating about 5 per cent higher than my customer's needs."

3. "I'll do what I can before I start. The more I can resolve on paper, the less trouble I'll have later on."

A plan is a standard of performance.

Like the political candidate who is against sin and for motherhood, every manager is against chaos and for planning. Without some sort of plan or standard there is no way accurately to measure progress. And about the only thing that you can be sure of then is that everybody is supposedly working and that eventually the project will phase out.

One of the main reasons for the existence of any project manager's job is the recognized necessity for directing and coordinating both people and material into a unified project. A project manager should be able to forecast reasonable solutions to such problems as:

Two problems in need of plans

- How many machinists are required to keep 20 screw machines operating?

- How much income will be available during the second half of the year for overhaul of heavy cruisers and destroyers at the naval shipyard.

As a general rule, the more the manager can resolve on paper, the less trouble he will have later. Erasers are inexpensive. Scrapped hardware is not. Unfortunately, a manager never really has all the necessary data. Consequently, as part of his job, he must constantly seek to

Three steps essential to effective planning

1. Recognize what data are missing.

2. Evaluate the possible effects of the missing data (such as increased costs, missing delivery schedules, etc.).

3. Revise his plan.

Key Term — 1. A way of doing something. A systematic presentation of what must be done on a project and when these tasks must be completed.

Focusing Quiz — You should have circled items 2 and 3. The text that follows explains why.

Analyzing Quiz

By following through on an industrial problem introduced earlier, we can illustrate these steps. The first step is given. Fill in the second and third steps yourself.

> The problem: How many machinists are required to keep 20 screw machines operating?
>
> The initial plan: One machinist can operate two screw machines. Ten machinists, then, would be required to operate 20 machines.

Step 1: Recognize the missing data.
Absenteeism generally accounts for a 10 per cent workforce decrease.

How might the data in Step 1 affect production?

Step 2: Evaluate the effects of the missing data.

____

____

____

Step 3: Revise the plan.

____

____

____

As plans become more specific, then, the crises should begin to disappear; they are being forecast and solved on paper. And if, in spite of all the plans and revisions, an honest-to-goodness crisis suddenly presents itself, the manager will be able to proceed to make new plans for its solution, since he will be able to determine cause and effect on paper.

Analyzing Quiz

Step 2: If the company-wide pattern of absenteeism were to apply to your machinists, you would have one machine idle on most days.

Step 3: Request 11 machinists instead of 10. Of course, when all 11 machinists report for work you would have another problem to solve. But at least all of your machines would be operating.

There is always the possibility of surprise.

Of course, there will always be cases where he will not be able to specifically determine the effects of his plans. Suppose, for example, that in the case of the machinists and screw machines, that he carefully evaluates supplies, equipment, and people, and obtains inputs from engineering, procurement, and production. Even with all this, however, he will have to finally recognize that it is unlikely that he will be able to nail down a schedule to the last unit. In such a situation, he might want to put out a schedule approximately 5 per cent higher than either his best estimate or the customer's needs. In many cases, this goal (or some other above-need goal) will be achieved simply because it has been set up as a standard. On the other hand, if this higher goal is really unattainable, it will be a lot easier to listen to excuses about how impossible it was when it fell 5 per cent short because the "real" delivery requirement (which the manager alone knows) has been met. This 5 per cent safety factor *or any other reasonable safety factor* that he selects can be useful when the inevitable delivery crisis appears.

Formal and Informal Planning

For a more complete discussion of informal planning and delegation of responsibility, see "Follow-up Techniques," J.A. Burgess, Machine Design, *April 29, 1965, pp. 183-185.*

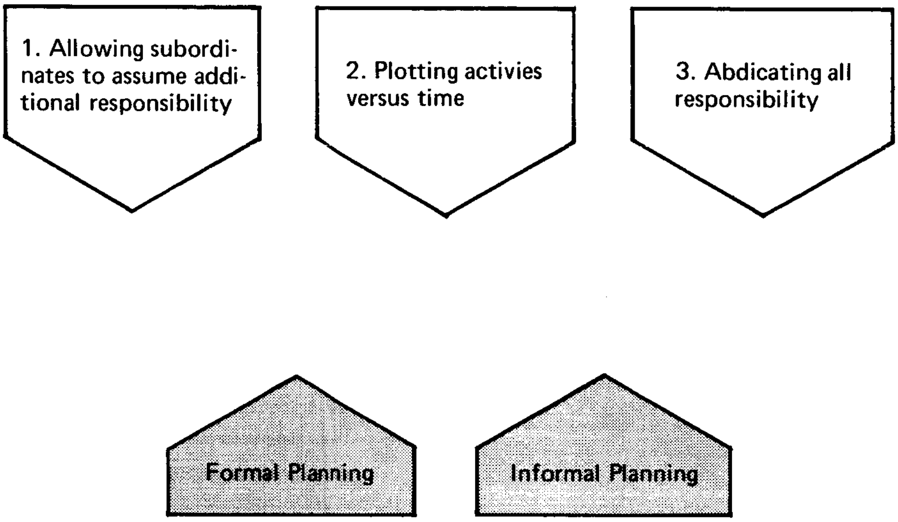
A project manager is accountable for everything that happens on his project. He may and should delegate as much responsibility and authority as is required to get the job done. How well the subordinate controls and directs his delegated responsibilities dictates the informal planning and follow-up that the project manager must do. There is a sensitive balance between the extremes of autocratic attention to detail and abdication of responsibility. He must use only the minimum of control to ensure task completion and at the same time allow his subordinate a maximum freedom of action. The fewer restrictions the subordinate has, the better trained he becomes to assume additional responsibilities. The project manager is there not only to direct but, equally important, to develop his people's management abilities.

Achieving these objectives involves the application of informal plans. Informal planning can be most effective when it is based on a formal plan. A formal plan is necessary because the problems faced by the manager of a once-through or research-development project invariably seem at first to be unique and mystifying. No one has ever been in exactly the same position before, because this project has never been done before. One of the most satisfying management experiences occurs when the manager finds that he can control his project successfully. Use of modern rationales and techniques to achieve this mastery can be a gratifying experience.

This need for formal planning was partially solved back in the early 1900's by the use of a Gantt or a milestone chart. By plotting activities as the *Y* axis and using time as the *X* axis, an over-all scheme showing interrelations between actions was laid out. More recently devised formal-planning techniques include PERT (program evaluation review technique) and LOB (line of balance). Other operations research techniques, such as linear programming, game theory, and queuing theory, can be used in allocation of resources. However, because in this course we are concerned mainly with over-all planning, we will limit ourselves to over-all control techniques.

Reviewing Quiz

Are you sure of the difference between formal and informal planning? Each phrase in a white box suggests formal planning, informal planning, or neither. Draw a line to connect each phrase to the correct shaded box. Draw no line if neither shaded box is appropriate.



Gantt Charts and Milestone Charts

Key Terms

Let us now focus on two valuable formal-planning tools – Gantt charts and milestone charts. But first, two key terms:

Task

A given kind and amount of work that must be completed in a set time.

Reviewing Quiz 1. Informal Planning 2. Formal Planning 3. neither

Achievement

1. An accomplishment.

2. A goal that should be reached through the performance of an assigned task.

Gantt charts and milestone charts — similarities and differences

Both Gantt charts and milestone charts plot activities against time. Yet, there is a distinct difference between the two. Gantt charts show the duration of actions; in other words, they show tasks. Milestone charts show achievements. We will illustrate this difference with the case of a fluid-valve-development project. The tasks that are a part of this project are:

1. Make layout drawings.
2. Get quotations from vendors.
3. Make-or-buy.
4. Write operation sheets and set up tooling.
5. Manufacture toolroom lot.
6. Test.
7. Correct drawings.
8. Change tooling and test fixtures.
9. Manufacture first production lot.
10. Test.
11. Ship.

And the Gantt chart developed from these tasks looks like this:

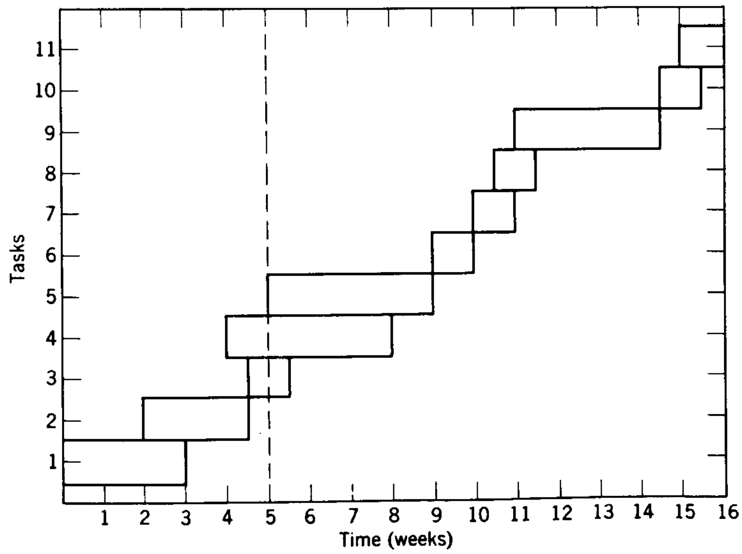


Figure 1

Gantt chart for fluid-valve-development project

To develop a milestone chart, we must first compile a list of milestones, or achievements for each of the project's tasks. The milestones for the fluid-valve-development project are:

Each milestone is a key goal of a task on the last page. Milestone a *is a goal of task 1; milestone* b *is a goal of task 2; and so on.*

a. Complete assembly drawing.

b. Start vendor quotations.

c. Complete make-or-buy.

d. Finish tooling.

e. Start toolroom lot.

f. Finish testing.

g. Finish corrected detail drawing.

h. Finish test fixture.

i. Start production lot.

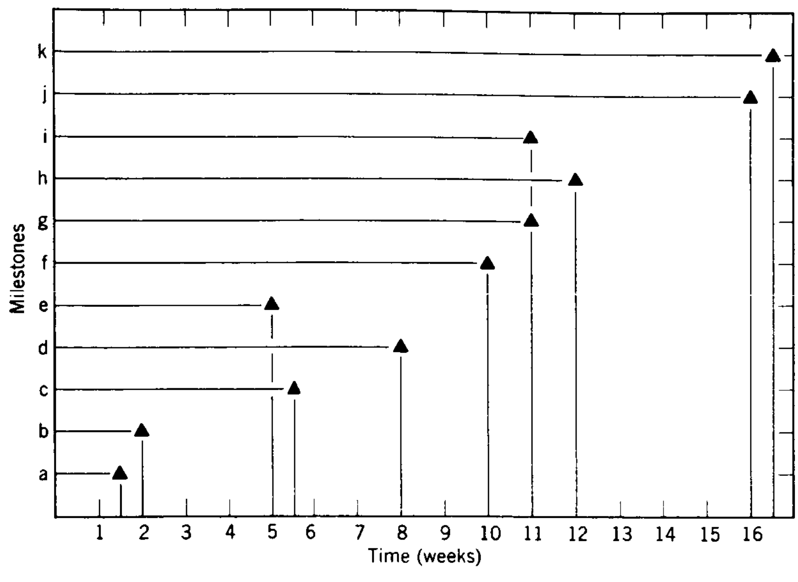
j. Finish test.

k. Complete shipment.

We then figure out at what point in time – in this case, after how many weeks from the beginning of the project – we expect each milestone to be reached. (Milestone *a* should be achieved about a week and a half into the project, for example. Milestone *b* after a total of two weeks.) With this information, we can make up the following milestone chart:

Figure 2

Milestone chart for the fluid-valve-development project



Reviewing Quiz

Study the Gantt and milestone charts carefully. Then read the following statements. If a statement refers to a Gantt chart, fill in a *G* in the appropriate box. If it refers to a milestone chart, fill in an *M*.

☐ 1. Allows you to see which tasks are going on at the same time.

☐ 2. Allows you to see how far toward the completion of a task you should be at a given time.

☐ 3. May be used for evaluation of a straightforward problem but may be inadequate for more complex projects.

Answers appear at the bottom of page 11.

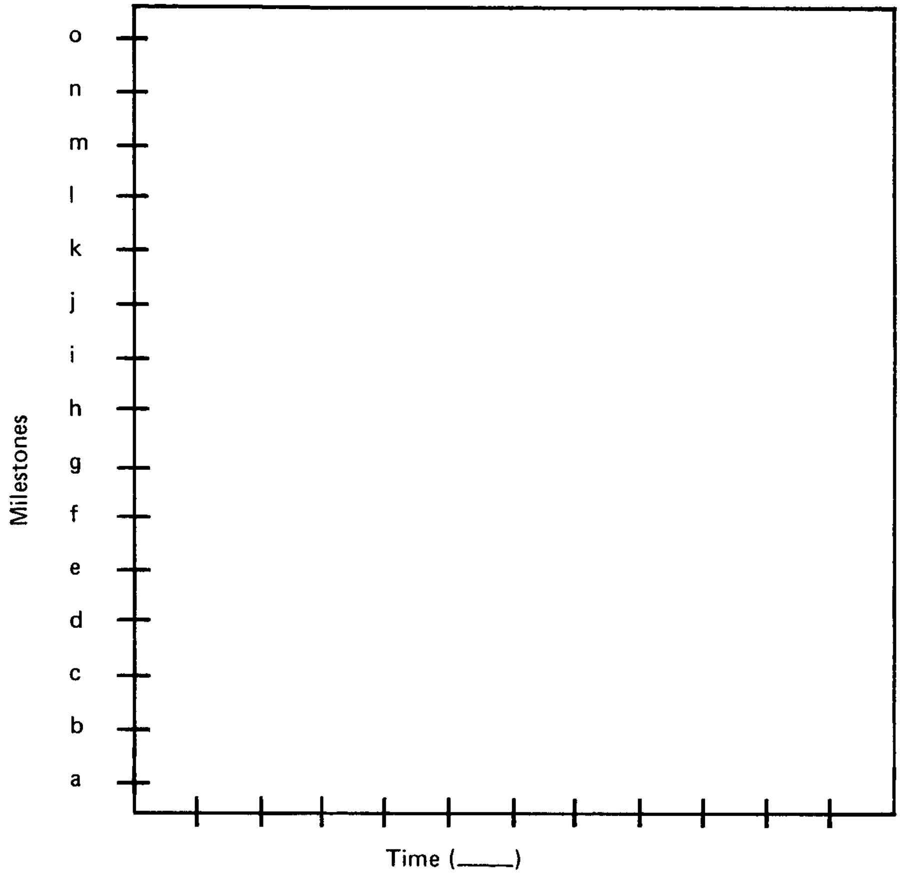
Your Dry-Run Project

Now prepare to make your own milestone chart.

In this column, list all the tasks you used in your Gantt chart on page 2-19. (New data may have come to mind in the meantime. If necessary, revise your tasks accordingly.)	In this column, list what you feel to be the milestone of each task. Remember: Milestones are the key achievements of tasks, not necessarily the end achievements.	Indicate the time by which you feel each milestone should be achieved.
1. ____________	a. ____________	________
2. ____________	b. ____________	________
3. ____________	c. ____________	________
4. ____________	d. ____________	________
5. ____________	e. ____________	________
6. ____________	f. ____________	________
7. ____________	g. ____________	________
8. ____________	h. ____________	________
9. ____________	i. ____________	________
10. ____________	j. ____________	________
11. ____________	k. ____________	________
12. ____________	l. ____________	________
13. ____________	m. ____________	________
14. ____________	n. ____________	________
15. ____________	o. ____________	________

Using the data in columns 2 and 3, prepare a milestone chart.

Model your Milestone chart after the one on page 9.



Indicate whether the time is in days, weeks, or months.

Incident

Consider what you have just read about Gantt charts and milestone charts as you read the following incident.

A fund-raising project for the local symphony

Some months ago Margaret Buck had been put in charge of the annual fund-raising project for the local symphony. She had been working with two other people who had been active in symphony projects for a number of years. As a project team, their assignment was to raise an additional $100,000 for the local symphony by the start of the fall season. While things had been going quite well so far, the entire project team felt that the major upcoming social fund-raising activity was not going as it should. The project team had worked closely with

Reviewing Quiz

1. G 2. G 3. M For example: the Gantt chart shows that in the fifth week you should be in the middle of make-or-buy decisions (Task 3), have started the operations sheets and tooling (Task 4), and begun the toolroom lot through the manufacture cycle (Task 5). The milestone chart shows none of this.

the symphony social committee and had given them the assignment of actually conducting the fund-raising dinner. The date had been set for that dinner and the social group had agreed to take full responsibility.

It was now only four weeks until the dinner and the feeling of the project group was that things were not going well for that activity. In fact, it appeared that the promotional materials for it were not coming along as rapidly as they should be and that all of the physical arrangements were behind schedule. However, every time the project team inquired as to the dinner's status and whether or not help was needed, they were told that the social group was doing its job. In fact, Margaret had recently been told by the head of the social group to just leave them alone, since the social group was convinced that they would meet their assigned objectives, and as long as they did so, Margaret should not worry about it. Margaret's problem was that all indications were that they would not meet it, and yet she did not have the authority to really take over that part of the project.

What is the major problem here and how could it have been avoided?

Program Evaluation and Review Technique (PERT)

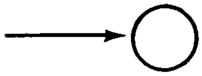
A third tool for formal planning is PERT. PERT is a variably complex once-through control technique designed to handle uncertainties in producing a single item or design. If only a few interrelated actions must be controlled, the analysis can be a hand-drawn chart brought up to date periodically. For a Polaris Missile Weapon System project, it can be a thousand activity chart updated by computers.

Incident

The major problem here is that as project head, Margaret has delegated a substantial amount of her authority to the social committee without setting up any control procedure to monitor fulfillment of that responsibility. If she had defined a number of milestones for the social committee (that is, with their help), she could have then monitored progress being made and taken any necessary action to correct problems before they became significant. As it now stands, she must either go back on her delegation of responsibility or simply hope for the best and wait until the entire project is completed.

Milestones and events contrasted

Like the Gantt chart, PERT makes use of tasks. And like the milestone chart, it shows achievements. Here the achievements are not milestones, however – not necessarily the key achievements of tasks – but rather terminal achievements. These terminal achievements are called *events*. Arrows are used to represent tasks; circles to represent events.



As an example, we can still use the fluid valve. The activities that are of concern can be tasks 1 through 11 as noted on the Gantt chart. The events are as follows:

a. Complete drawings.

b. Complete quotations.

c. Complete make-or-buy.

d. Complete operation sheets and tooling.

e. Complete assembly toolroom lot.

f. Complete test.

g. Complete detail drawing revision.

h. Complete test fixture change.

i. Complete first production lot.

j. Complete final test.

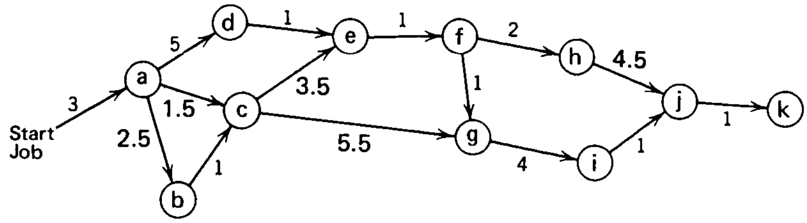
k. Ship.

Each task, then, is limited by an identifiable event. The event has no duration; it simply serves to tell you that an activity has ended or begun. Except for the first tasks, all activities must have a beginning and an ending event. No task can start until all tasks upon which it depends are completed. There can be no "looping back" of activities in PERT, for a sequence that leads back to an activity will never end.

Your lists of tasks and events are the basis for the following PERT diagram.

Figure 3

PERT diagram of fluid-valve-development project



Arrow length is not significant, but the sequence and interconnections must give a true picture of the tests that must be completed before the next task becomes possible. (Here, we have assumed that the simultaneous tasks of Figure 1 have become sequential.) The numbers shown on the activity lines between events correspond to an estimate of the time required between events. In this example, the time is noted in weeks. According to Figure 3, it takes four weeks from the end of the detailed drawing revision until the first production lot is completed – the time period from *g* to *i*.

The longest path through the network is the *critical path*. Since all other paths through the network take less time, the critical path is the one that will determine the project completion date. Any delay in the critical path will affect the schedule, any delay in the other paths could possibly be corrected without affecting the schedule.

Shade in the events along the critical path in Figure 3.

The planning of a task, using networking, can be applied to almost every action, including determining how and when to paint a living room so that it will be finished during a vacation. In some cases the network and its control can be extended into a situation that could require expensive computer inputs; however, if kept within a reasonable number of events, the manager can control it by hand notations at minor administrative costs.

When the project manager uses PERT, it quickly becomes apparent that planning and networking are rather rigorous jobs. The laying out of the activities themselves becomes beneficial because it requires a logical basis to achieve a goal. In fact, unless the problem to

Critical Path

Critical Path = Start – a – b – c – e – f – h – j – k
3 2.5 1 3.5 1 2 4.5 1

be solved is a tremendously large one, most of the benefit results from the networking task alone. Networking requires a "try-to-think-of-everything" attitude. The manager may otherwise overlook potential problem areas.

Your Dry-Run Project

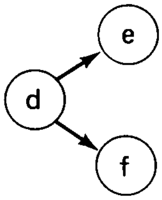
Now take these steps to make a PERT diagram for your own project.

Step 1: List all the tasks that must be performed. Use column 1 on page 10 for this purpose. Rewrite this list in the left-hand column below.

Step 2: In the right-hand column, list the events that terminate each task.

Step 3: Identify the different paths that will make up the network.

Ask which tasks can be performed simultaneously and which can only be begun after others have been completed. For example, suppose task 4 (which culminates in event *d*) must be finished before either task 5 (event *e*) or task 6 (event *f*) can be begun, and that tasks 5 and 6 can be performed simultaneously. You would indicate these relationships as follows:



Use the space below to work out the paths through your project.

Step 4: Estimate the time needed to complete each task.

Never estimate times in over-all network sequence. Establish estimates randomly so that any bias as a result of schedule is minimized.

Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Time estimate															

Step 5: Make your PERT diagram.

Step 6: Identify the critical path.

Shade in the events along the critical path in your diagram.

Always be ready to improve the network.

A manager should not become enamored with his own cleverness over the network. It is only one way to do the job; it may not be the best, and it is subject to change as the project progresses. The higher the caliber of the personnel that he has monitoring the PERT chart, the better control he will have. The cost of frills in management is high; therefore, when the chart is sufficiently detailed for its purpose, one should not continue to refine it. As the network increases in complexity, it also increases in cost. In this work, as in all management planning work, when the cost of obtaining the data approaches the value of the data itself, the manager should stop planning in such detail. Always check field conditions against reports coming in. A PERT chart does not replace an on-the-spot investigation of an activity. The manager should use face-to-face observation and communication whenever he has the time by actually going right to the machine shop or assembly room floor.

Always check field conditions against reports.

If this is the first time the project personnel have been exposed to PERT, this will probably be the first time the manager will face the "it will never work" neurosis. If there are those who say it will not work, they probably have not had a prior exposure to rigorous planning. A manager will never be able to convince them until he can prove it, perhaps by using the PERT chart to point out inconsistencies in plans submitted for his approval. On the other hand, maybe PERT is not appropriate for a simplified project. The manager should not "gold plate" the process.

Another way a project manager can gain the cooperation and enthusiasm of his project personnel is to allow the people responsible for their own segments of the network to lay out their respective portions. Later these smaller nets can be "stitched" together into an over-all project. In this way, the originators identify with their planned activities and develop a proprietary interest in seeing that they succeed.

Many of these practical ideas on PERT are based on "Network Management Techniques," Marvin Flaks et al., Factory Magazine, *March 1964, 87-94.*

Management by exception is used to check actual progress against PERT predictions. The manager is mostly concerned with the longest path (usually the most critical) through the network. The other shorter paths are only checked occasionally to be sure that they do not vary from the schedule to the degree where they become critical themselves.

After the first few times, the PERT charts for different problems in the same organization will begin to show an over-all similarity. It should be possible to set-up several standard subnetworks and to use them as building blocks to build a new network, as needed, at minimal expense. In the same plant the actions and time required to draw prints of a new design of a valve should be fundamentally the same as the last valve designed.

PERT-COST is a cost projection-status report based on a PERT activity chart with costs attributed to each activity. It is possible, *For a more detailed discussion of PERT-COST, see "Project Scheduling – The Second Generation, J.J. O'Brien,* Machine Design, *April 29, 1965, pp. 172-181.*

therefore, to plan total cost against contract cost in the same manner as total delivery time in PERT against contract delivery time. Another plannable attribute is manpower, handled similarly to time in PERT or money in PERT-COST.

The variations of PERT (or critical path method as the building industries call it) are numerous. It is not the manager's function to become an expert on PERT and its variations. He is a management expert and PERT is just another tool to help him do the primary job, that of managing. If the project is large enough, he can get an expert to handle the PERT chart.

Reviewing Quiz

Now check your mastery of what you have just read. Put the following PERT steps in the proper order by filling in the boxes with the numbers 1 through 5.

☐ a. Identify events

☐ b. Identify tasks

☐ c. Manage by exception

☐ d. Identify critical path

☐ e. Make diagram

Line-of-Balance (LOB) Technique

The transition from the conception and definition phases to the acquisition phase requires a different control tool – LOB. Here we will set up an LOB for a hydraulic control known as Hydropack. Our intention will be to forecast production quantities of required components which will allow us to ship the required number of assemblies at the right time in the future.

Step 1: Prepare a flow chart.

As a first step, certain cognizant production personnel must lay out a flow chart to show when the parts are to be made or bought and how they flow together to make subassemblies and assemblies. We will work backwards from the finished product (zero time) to the major and then the minor parts. "Major" and "minor" here refer to how long the part is in the processing stream, not to how large or critical the part is or to how long the processing actually takes.

For a more thorough treatment of this point, read "Techniques of Management," M. Silverman, Product Engineering, *Oct. 15, 1962, pp. 73-78.*

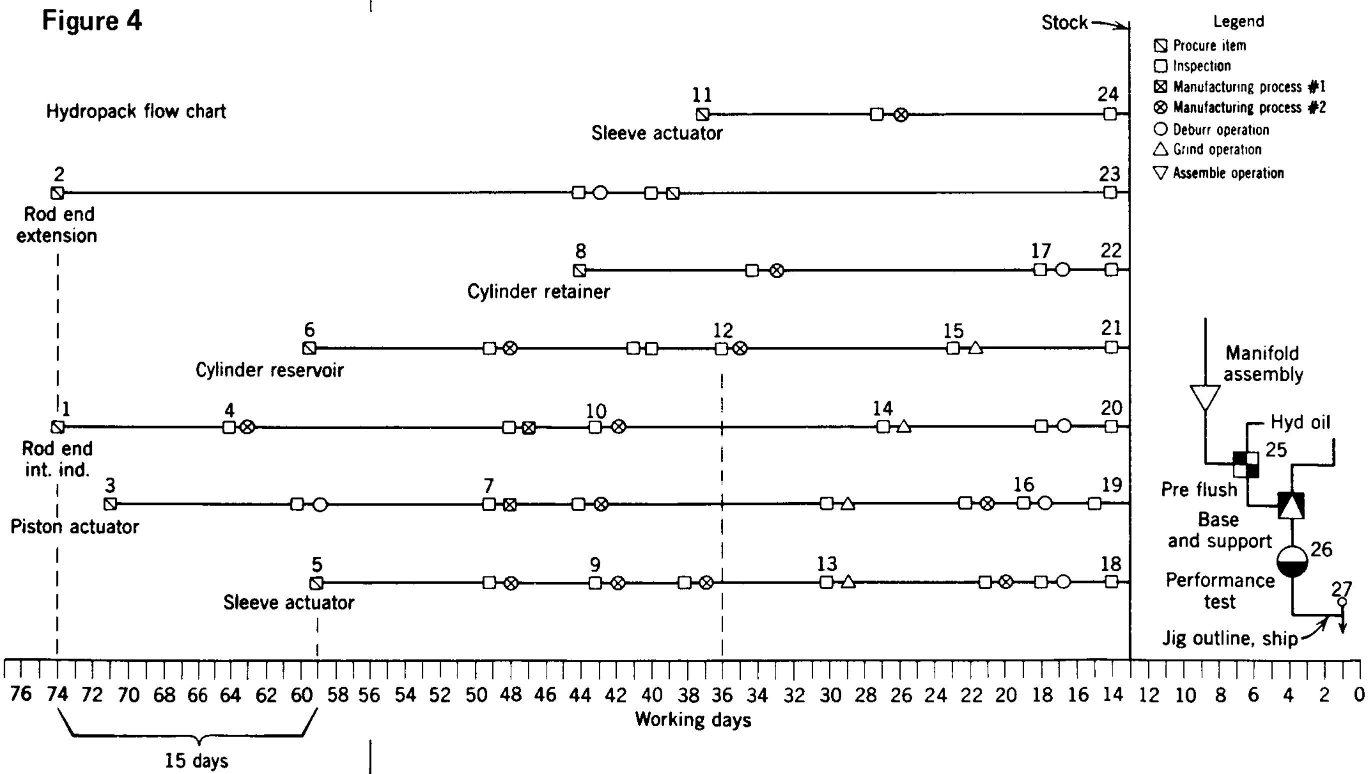
Reviewing Quiz a. 2 b. 1 c. 5 d. 4 e. 3

For example, it takes one hour to machine a hole; and consequently, when we are processing a 100-piece lot, the minimum time we should allow for this operation is 100 hours. To this we must add setup, delay, and movement time. The finished flow chart time generally has little relationship to the processing time. The chart may show months, whereas the unit processing time may be in hours.

Measure time horizontally; here the line (activity) lengths are important, as opposed to the PERT chart, where they were not. Working days are plotted as the *X* axis. The flow chart goes from zero (shipping) time on the right to maximum (ordering) time on the left.

Now we should number the important milestones, or benchmarks, which we will be monitoring. Various supervisors will report progress on all of these points at monitoring intervals. Number from left to right in time sequence, so that a lower number is always to the left of the higher number. The shipping date has the highest number. Keep the number of benchmark points to the minimum needed to give you a clear idea of what is going on – the more benchmarks, the more laborious the job.

Figure 4



The actual planning of the PERT network is valuable as a management discipline; similarly, this LOB flow plan is important, because it will enable the manager to pinpoint inconsistencies in processing and opportunities for simultaneous activities. [In the example shown in Figure 4, the sleeve actuator (beginning with event

#5) need not be started until 15 days after the rod end extension has started in production – 74 days minus 59 days, event #2 time, minus event #5 time.]

Reviewing Quiz

Now review what you have just read about the substeps of LOB step 1. These substeps appear below, but out of order. Put them in the proper order by filling in the boxes with the numbers 1 through 4.

Step 1: Set up a flow chart.

☐ a. Identify the assemblies and subassemblies.

☐ b. Identify the finished product.

☐ c. Chart the manufacture of the assemblies and subassemblies, backwards, from completion date to beginning date.

☐ d. Indicate and number the important milestones.

The following step-1 checklist contains some bad advice for the application of LOB. Cross out each inaccurate suggestion.

✓ 1. Focus on processing time only.

✓ 2. Pinpoint as many milestones as possible.

✓ 3. Work backward from the finished product.

✓ 4. Consider setup, delay, and movement time.

✓ 5. Aim toward establishing the dates when assembly and subassembly parts are to be made or bought.

Step 2: Plot projected and actual delivery.

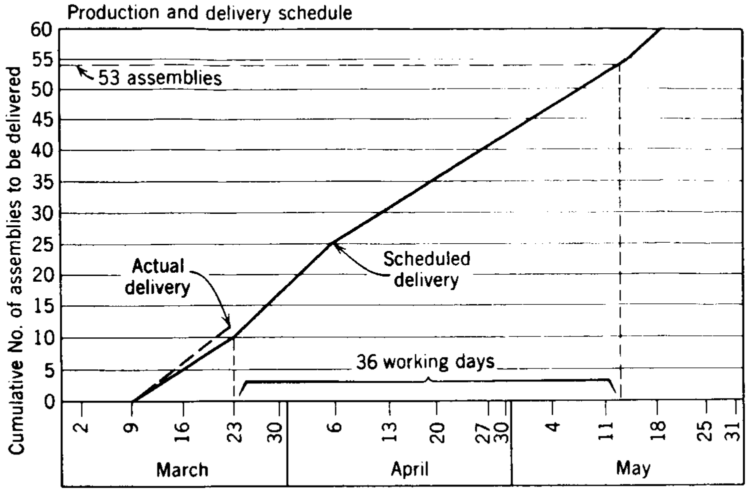
Next we make a cumulative plot (Figure 5) of delivery requirements that will also carry a cumulative plot of actual shipments. Horizontal differences between the two figures are a measure of time delay or advance for the same amount of actual shipments as the scheduled shipments. Vertical differences indicate quantity delay or advance for the same point in time. Slope differences indicate variations in production rate.

Reviewing Quiz   a. 2   b. 1   c. 3   d. 4

You should have crossed out checklist items 1 and 2.

Figure 5

Cumulative schedule shipments

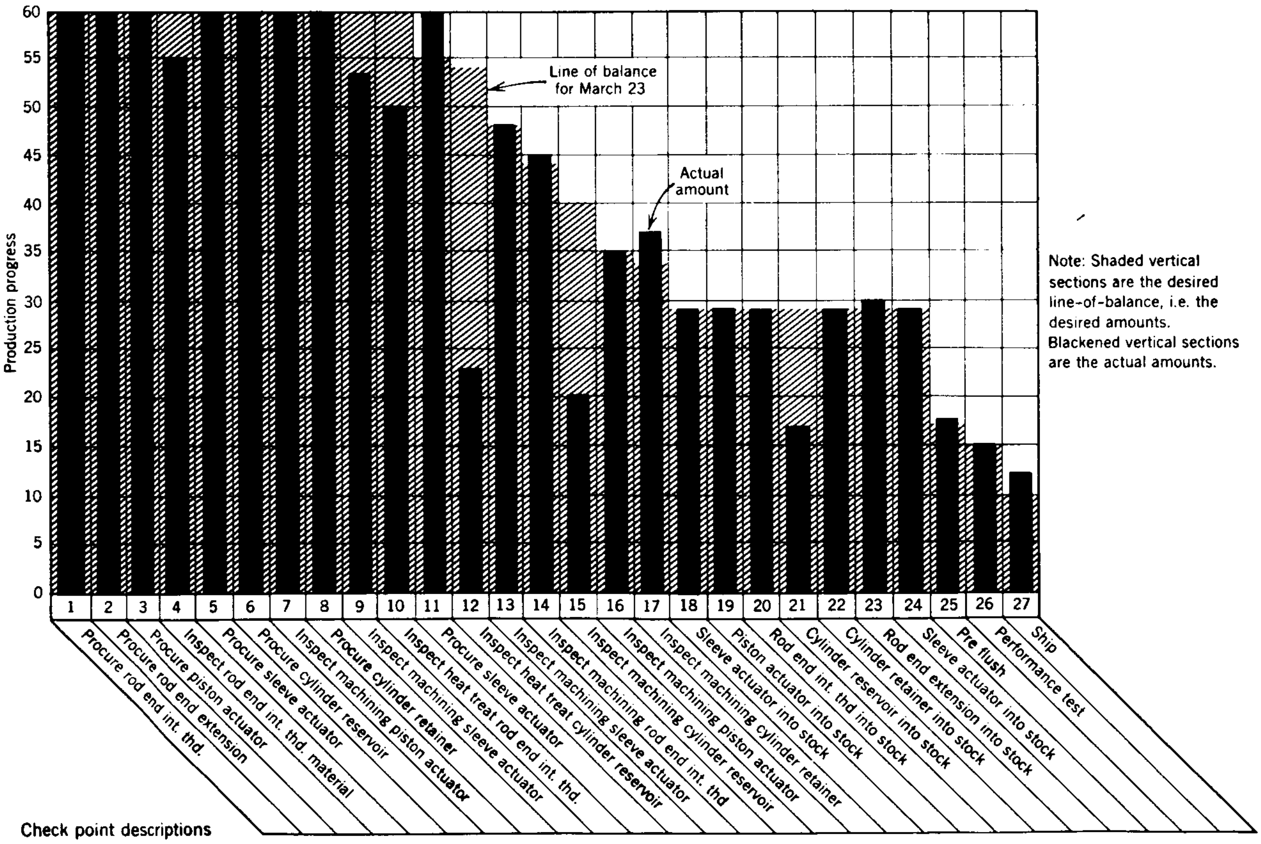


Step 3: Prepare a LOB bar chart.

The next and last chart is simply a bar chart on which the number of parts or subassemblies which have passed each benchmark to date is plotted. On this chart, we can actually draw the Line-of-Balance. Suppose today is March 23. Benchmark 12 on the Hydropack flow chart must be passed 36 days before final delivery. On the delivery schedule,

Figure 6

Line-of-Balance chart



36 days forward from March 23 brings us to May 13, when 53 assemblies are to be delivered.

On the bar chart (Figure 6), we can draw the March 23 LOB crossing Benchmark 12 at 53. It crosses Benchmark 15 at 40, Benchmarks 18-24 at 28. This line of balance tells us exactly how many parts and assemblies should have passed each benchmark by the date under consideration, if the scheduled delivery is to be met. An in-process report covering how many parts or assemblies actually passed each benchmark on March 23 is plotted on the LOB. The desired actual is one which just meets the plotted line. Too many parts completed ahead of time ties up capital unnecessarily. Too few parts may mean a missed delivery schedule.

Finally, a periodic production report lists each benchmark that lags behind schedule and notes the corrective action that has or will be taken. This last report is another confirmation of the management by exception idea.

Figure 7

LOB production report

PRODUCTION REPORT – 23 March 1975

Check Point	Description	LOB Req'd	LOB Actual	Corrective Action
2	Procure Rod End Extension	60	58	2 pieces due in tomorrow
4	Inspect Rod End Internal	60	55	5 pieces in process
9	Inspect Machined Sleeve Actuator	60	53	7 pieces in process
10	Inspect H. T. Rod End	60	50	Vendor delay – 15 pieces tomorrow
12	Inspect H. T. Cylinder Reservoir	53	23	Vendor delay – 40 pieces tomorrow
15	Inspect Machined Cylinder Reservoir	40	20	Holdup – checkpoint 12
21	Cylinder Reservoir Into Stock	28	17	Holdup – checkpoint 12

Other uses of LOB

The LOB can also be used to project the funds required at any point in the production cycle. By counting the required number of purchased items at a given time, one can determine the accounts payable. By counting the number of manufactured items required, multiplied by the number of manufacturing hours per item, one can determine the payroll requirements.

The production LOB shows the minimum requirement of each component that goes into an assembly to meet a future delivery at a point in time. It projects trouble areas and allows time for correction prior to the crisis stage.

Reviewing Quiz

Now review what you have read about LOB. Each phrase on the left indicates a function served by one or more of the LOB instruments on the right. Draw lines to correctly match the two columns.

1. Measures quality delay or advance of actual shipments against projected shipments for the same point in time
2. Indicates how many parts and assemblies should have passed each benchmark by the date under consideration
3. Measures time delay or advance for the same amount of actual shipments as the scheduled shipments
4. Shows when parts are to be made or bought and how they flow together to make assemblies and subassemblies
5. Notes corrective action to be taken to make actual LOB match required LOB

A. LOB production and delivery schedule

B. LOB bar chart

C. LOB production report

D. LOB flow chart

Input-Output Control Methods

For more on input-output control, read "Planning and Controlling Project Performance," E.C. Soistman, Martin-Orlando, April, 1965

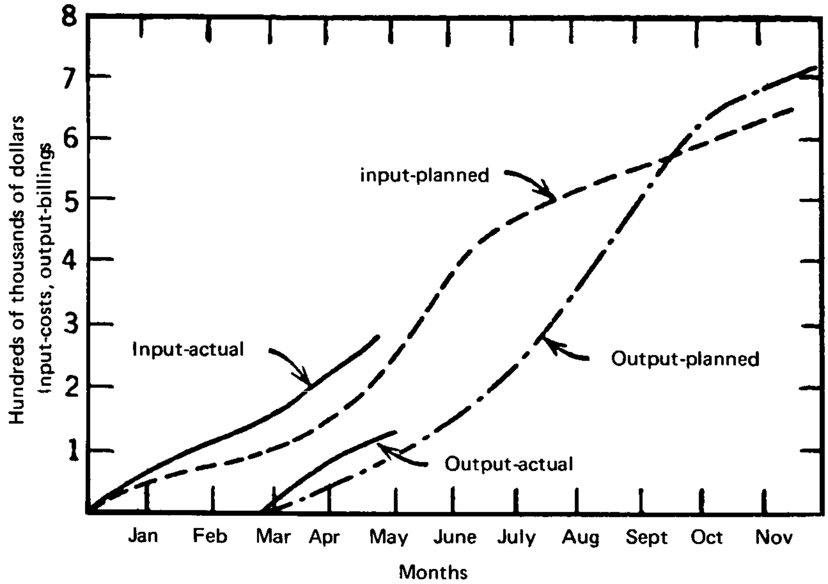
Input-output control methods reflect an actual expenditure and accomplishment versus a plotted forecast. Each area of a project is assigned a task and the task leader forecasts funding and accomplishment rates. The inputs are the funds and the outputs are the achievements, measured in billings.

Both input and output plans must agree with the contractual requirements and the allocated funds. When actual costs and achievements begin to appear, the manager can have an evaluation of the effectiveness of his program and/or planning.

Reviewing Quiz 1. A 2. B, C 3. A 4. D 5. C

Figure 8

Input/output performance



Analyzing Quiz

Check the appropriate box to show whether the listed inputs and outputs are above or below amounts forecasted in Figure 8.

Months	Input-costs x $100,000	Above forecast	Below forecast
1. July	4		
2. September	6		
	Output-billings x $100,000		
3. August	5		
4. October	6		
5. November	8		

Analyzing Quiz 1. below 2. above 3. above 4. below 5. above

The Content of the Project Plan

The project plan is one of the most formalized planning techniques since it is a published management document which describes project objectives, definitions, requirements, interfaces, and schedules, and in addition answers specific customer requests. It is maintained throughout the life of the project as a base line but may have revisions if the direction of the project changes. It can include PERT, LOB, or any other planning that is used.

The plan may be a minimal one if it is to be distributed only within the organization. A plan involving a plant building addition is an example of this. The only general requirements are that it show the answers to

What

How

Why

Where

When

In the highly technical industries, because of customer's detailed requests, the project plan may include many volumes.

If the project is established in answer to a specific customer request, the plan may include descriptions of the project procedure and practices, management organization, resumes of principal personnel, and other information to satisfy the customer's stated requirements.

When the writing of a project plan is a normal activity for your industry, it is possible (and probably quite necessary in order to meet schedules) to write certain portions before a need for them arises. Familiarity with your industry requirements might indicate that your customer would want to know how your project would operate to satisfy his needs. This could include, for example, a description of your company's quality control, production control, cost accounting, purchasing, engineering documentation control, and contracts management procedures.

Assuming that these procedures already exist in written form, the plan can be assembled from them, adding only definite project objectives, written specially for the plan. For example, the purchasing procedures of the organization may already document who initiates a requisition, what is supposed to be on the requisition, who must approve it, and what route it must follow. This can then be used in the project plan, modified only by specific project and customer requirements.

This point is more fully examined in Chapter 5.

As a general rule even if it is not required by the customer or the organization management, it is wise to write a brief project plan before expending any great amount of organization funds. This plan may be limited to your over-all project objectives, how you intend to achieve them, the benefits to be expected, and the costs to be expended. This information can be most valuable to your top management.

Informal Planning: Project Control Documentation

Informal plans are not casual or sloppy plans.

Formal planning mechanisms such as PERT and LOB are too cumbersome for day-to-day control. However, even for informal day-to-day work, the manager should document every decision, every direction, every achievement that he wants accomplished. The old adage about not giving verbal orders still holds. When it is on paper, it is less apt to be misinterpreted, ignored, or pushed aside. Additionally, different kinds of documents get different kinds of reactions. A telegram has always been a greater attention-getting device than a phone call, as a good salesman will tell you. A printed manual has a different impact from a hand-written memo. There is a limit to which this policy should be followed, but only the project manager can decide what this limit is. If his personnel are well trained and well motivated, the amount of documentation can be minimized. On the other hand, if they are not, all the written orders in the world will not help him complete the project per plan.

Figure 9

An action plan: see the first item in the checklist on page 28.

Project: Hydro

Task	Assigned to	Date of assign-ment	Date schedule completed	Remarks
1. Review customer test specifications	J. Jones	1/8	2/3	Review for change in scope
2. Prepare heat test results	A. Smith	1/8	2/1	
3. Obtain field rejection results	B. Roberts	1/10	2/5	Check against prior month Q.C. report

Here are some useful informal-planning documents. Check the boxes before those that you feel are compatible with your own managerial style.

☐ When outlining a task, a *checklist of items* to be done can be very useful. Such a list – an example is shown at the bottom of page 27 – may be sent to the individuals concerned immediately after they have been assigned a specific task.

☐ A *periodic status report* summarizing all open action plans is also useful.

☐ If a problem is important enough to require a meeting of more than two or three people, the meeting is important enough to have *minutes*. These minutes of meetings should be distributed to all concerned when the agreements reached, and the action required, are too few or too many for separate action plans.

☐ *Internal memos* may also be used to give direction. (Be sure to include the subordinate's "spiritual" leader in the distribution.)

☐ Still another control device that is personally helpful is a *desk diary* or *log*. There are so many factors that can easily influence the extent of the diary that only a few of the more obvious will be mentioned here as examples. Record the substance of a telephone conversation with the customer in which he informally requests a blueprint since someone may want to know later on why it was sent out. Note your reasons for directing that procurement buy an extra supply of *O* rings – that is, you have been informed that 20 hydraulic repairs are on the way and because repair delivery can be affected by an *O*-ring shortage and the rings do not cost too much, you want an extra thousand ordered. Record a note to yourself that you should reallocate some funds first thing tomorrow morning to account for some special overtime on test equipment which is late. As you go along, the nature of the data you receive and the need to recall or justify the initial data will dictate the desk-diary contents.

Have you ever forgotten a key bit of information that you could easily have jotted down in a diary?

The desk diary can be a useful device to avert a potential controversy, which can occur, for example, when you have approved an engineering request for additional overtime to complete a test in order to meet a delivery requirement. Normally this would require changing allocation of funds and a consequent internal memo of some sort. However, the lateness of the hour during this day required your immediate decision. By documenting this approval in your log (and allowing the specific engineer to see you doing it) any changes or misinterpretations of your approval can be minimized. The format of the desk diary should therefore be understandable to others.

Do not discard other casual information links entirely for documented ones. The efficiency you attain in planning and follow-up, as measured by concrete achievements and crisis avoidance, is enhanced by "casual" conversation. You can pick up a great many warning signals and constructive hints just from listening to people. The complaint of the production engineer who says he is having a great deal of difficulty getting tools made becomes understandable when you find out that the tool design function is under staffed. This may show up favorably on the cost charts as an under-expenditure, but you may not get your production line moving in time. The frequency and timing of these conversations should be carefully handled in order to appear casual and not repetitive. It is most desirable to cross-check down through your organization in order to feel a "pulse beat." Conversely it is not desirable to extend this technique into an over-the-shoulder inspection of your subordinates' management. Try to make the conversations face-to-face. There is a general tendency to be more formal if you use a telephone.

The value of a certain amount of random conversations

A tickler file oriented to time is a necessary adjunct unless you have a computerlike memory. You are the best judge of the extent of this file. If you set one up for each of your next line subordinates with specific dates for specific things to be done, you will be able to devote more time to over-all management.

Figure 10

Tickler file

Project: Hydro   Assigned: B. Jones

Assignment	Complete week of	Remarks
1. Prepare summary of program for management briefing 2. Follow up expense rate in assembly	2/3	1. Emphasize quality aspects of pump redesign 2. Correlate with assembly head count
1. Rough draft of second-quarter budget	2/10	1. Reduce machinist hours from first quarter by 20%

Reviewing Quiz

Now review what you have read about documents. Draw lines to connect each informal-control document (on the left) with the function (on the right) it best serves.

1. Checklist of things to be done
2. Periodic status report
3. Internal memos
4. Desk diary

A. Giving directions
B. Outlining a task
C. Summarizing all open action plans
D. Recording the substance of a phone conversation.

Why generate all these documents in the first place? The main function of any control documentation is to provide knowledge of functional activities. A secondary function is to maintain a repository of applicable data, such as engineering information, quality control plans, and production requirements. The documentation is used in the preparation and substantiation of budgets, and of equal importance, in the preparation of recurring reports to management on progress with respect to objectives.

If you wish to know more about what a good management control does, see AFSCM 375-3, 15 June 1964, p. 18.

Good management control will:

Be flexible to unforeseen project changes.

Be worth the cost of operation.

Satisfy the project needs with timely information.

Be understandable to the people affected.

Project potential failures and indicate corrective action effects.

Regardless of the control system used, these criteria will generally be determined beforehand if the need and the solution of that need are matched.

Reviewing Quiz 1. B 2. C 3. A 4. D

Summary of Chapter 3

Most crises can be foreseen and eliminated if sufficient time is devoted to obtaining data and planning the project activities based on these data.

- Gantt charts and milestone charts are two devices for plotting activities against time. The difference between the two is that Gantt charts show the duration of actions, while milestone charts show achievements. This means that Gantt charts allow the project manager to see which tasks are going on at the same time and how far toward completion of a task he should be at a particular time.

- PERT provides a mechanism for planning research-development contracts. It provides an early warning of problems and the possible effects of reallocating resources in an attempt to solve these problems. It is an easily visualized interrelationship between time, costs, and resources. It is a device for integrating project elements and monitoring progress.

- Line-of-Balance is a control system useful when in production since it effectively projects future detail requirements into a present assembly delivery schedule. This technique is useful in cash flow analyses, as are input-output charts.

These formal planning mechanisms are too cumbersome for day-to-day control, which the project manager can partially achieve by documenting every decision, every direction, every achievement that he wants to accomplish. For such informal control, he may wish to use checklists of items to be done, periodic status reports, minutes of meetings, internal memos, and desk diaries.

Chapter 3 Progress Check

Draw lines to connect each term (on the left) with its definition (on the right).

1. Milestone
2. Event
3. Achievement
4. Task

a. A given kind and amount of work that must be completed in a set time

b. An accomplishment

c. A key achievement

d. A terminal achievement

Fill in the missing word or words.

5. A ____________________ is a systematic presentation of what must be done on a project and when it must be completed.

6. ____________________ plot tasks against time.

7. ____________________ plot achievements against time.

8. The longest path through a PERT network is called the ____________________ .

9. To check actual progress against PERT predictions, ____________________ is generally used.

10. On an LOB flow chart, milestones are called ____________________ .

11. ____________________ methods reflect an actual expenditure and accomplishment versus a plotted forecast.

Circle the letter before the correct answer.

12. More details should be included in a plan when

    a. the consequence of not including them is great

    b. the project is complex

    c. both of the above

    d. neither of the above

13. The project manager should

    a. use the maximum amount of control

    b. develop his subordinates' management abilities

    c. both of the above

    d. neither of the above

14. Milestone charts

    a. are useful for evaluating relatively straightforward problems

    b. show which tasks should be in process when

    c. both of the above

    d. neither of the above

15. LOB includes

    a. a chart showing cumulative schedule shipments

    b. a bar chart showing the number of parts which have passed each benchmark to date

    c. both of the above

    d. neither of the above

Indicate true (T) or false (F).

16. No good plan will ever have to be revised. ____

17. As a general rule, a project manager should not set his goals higher than the customer's needs would indicate. ____

18. How well a subordinate controls and directs his delegated responsibilities dictates the informal planning and follow up the project manager must do. ____

19. Informal planning can be most effective when it is based on a formal plan. ____

20. PERT is an acceptable substitute for on-the-spot investigation. ____

21. LOB is a control tool used primarily for the acquisition phase of project management. ____

22. The LOB flow chart shows processing time only. ____

23. In preparing an LOB flow chart, the project manager should keep the number of benchmarks to a minimum. ____

24. LOB can be used to project the funds required at any point in the production cycle. ____

Answer briefly.

25. What are the principal advantages of planning?

26. What are the advantages of a Gantt chart over a milestone chart?

27. What is PERT and what functions can it serve?

28. What is LOB and what functions can it serve?

29. What is a project plan? What are some of the planning devices it might include?

30. What is project control documentation, and why is it needed?

Answers to Chapter 3 Progress Check

1. c 2. d 3. b 4. a

5. plan 6. Gantt charts 7. milestone charts 8. critical path

9. management by exception 10. benchmarks 11. input-output control

12. c 13. b 14. a 15. c

16. F 17. F 18. T 19. T 20. F 21. T 22. F 23. T 24. T

25. A plan provides a manager with a means for coordinating people and material, measuring progress accurately, avoiding major problems, and forecasting reasonable solutions to problems that arise.

26. A Gantt chart, on which tasks are plotted against time, has two main advantages over a milestone chart, on which achievements are plotted against time: First, the Gantt chart allows the project manager to see which activities are going on simultaneously. Second, it allows him to see how far toward the completion of a task he should be at a particular time.

27. PERT is a variably complex once-through control technique designed to handle uncertainties in producing a single item or design. It provides an early warning of problems and the possible effects of reallocating resources in an attempt to solve these problems. It is a device for integrating project elements.

28. LOB (Line-of-Balance) is a control system useful when in production. With LOB, a project manager can effectively forecast future detail requirements into a present assembly delivery schedule.

29. The project plan is one of the most formalized planning techniques. It is a published management document which describes project objectives, definitions, requirements, interfaces, and schedules, and in addition answers specific customer requests. It is maintained throughout the life of the project as a base line, but it may be revised if the direction of the project changes. It may include PERT, LOB, or any other planning device.

30. Project control documentation is the informal day-to-day documentation of every decision, every direction, every achievement that a project manager wants to accomplish. It is needed because such formal planning mechanisms as PERT and LOB are too cumbersome for day-to-day control.

Reynolds Construction Company

In 1973, Reynolds Construction Company received a contract to construct a water purification system for the city of Oakmont. By the fall of 1974, work was nearly complete on the main system; however, it was apparent that work on a special remote control building would have to be finished earlier than originally planned if the main system was to be completed on time.

Mr. James Alison, field construction supervisor for Reynolds, had arranged a meeting with Mr. Henry Phillips, project engineer, to restudy the arrow diagram of their critical path schedule for the construction of the remote control building in an effort to determine the shortest possible time in which the job could be done without spending more money than necessary.

Reynolds used the Critical Path Method as a tool to assist in project planning and control. Two documents are used in this control system, an activity network and a cost table. A list of the activities for the remote control site are in Exhibit 1. The activity network, Exhibit 2, shows all the activities and the sequence in which they can be performed. No activity can begin until all the previous ones on its path have been completed. The Cost Table, Exhibit 3, lists the activities and their duration along with the cost needed to complete them in this "normal time." The cost table also lists the minimum time for each activity, called the "crash" time; and the costs needed to achieve this minimum time. In addition, a final listing in the Cost Table shows how much it cost to shorten each activity one week. The sequence of consecutive activities requiring the longest time to complete before the end of the project is known as the "critical path" for that project. The path is considered "critical" because any delay in the particular sequence will delay the completion of the entire project.

Mr. Alison had the original diagram for the remote control building project (Exhibit 2) in his office. It was, of course, considerably simpler than the similar diagrams for the control of the entire construction job.

Using the data provided by the Cost Table for this project, (Exhibit 3), it was apparent to Mr. Alison that the critical path for this project followed the sequence of activities A-D-G and would require 12 weeks. The original project cost was estimated at $61,000. Mr. Alison could also see that the sequence of activities along one path, C-E-G, could lag as much as four weeks behind schedule without affecting the planned time for the completion of the project.

Although a computer was necessary for the rapid solution of critical path problems in larger projects, Mr. Phillips had manually worked out a schedule for this project which indicated that the job could be completed in nine weeks at a total cost of $77,000. The additional cost of $16,000 was largely attributable to the cost of extra shift operations necessitated by a "crash" program. It will be noticed that in his revised schedule (Exhibit 4), three paths had become critical to the completion of the project as rescheduled.

In their conference, Mr. Alison and Mr. Phillips concluded that a further speedup of the job was both necessary and possible.

Assignment

1. Reduce total project duration as much as possible without unnecessary additional costs. Indicate the new critical path or paths. Show how much slack time remains in the noncritical paths.

2. Assume that the situation proves to be less urgent than it seems to Alison and Phillips. Revise the schedule in order to complete the job within ten (10) weeks. Indicate the new cost and critical path or paths.

Exhibit 1

Job Label	Job Description	Immediately Preceding Jobs	Normal Time
A	Procure materials	Start	3
B	Prepare site	Start	6
C	Prepare request for Oakmont Engineering Department approval	Start	2
D	Prefabricate building and deliver to site	A	5
E	Obtain Oakmont Engineering Department approval	C	2
F	Install connecting lines to main system	A	7
G	Erect building and equipment on site	B,D,E	4

Exhibit 2: Critical Path Diagram for Remote Building Project

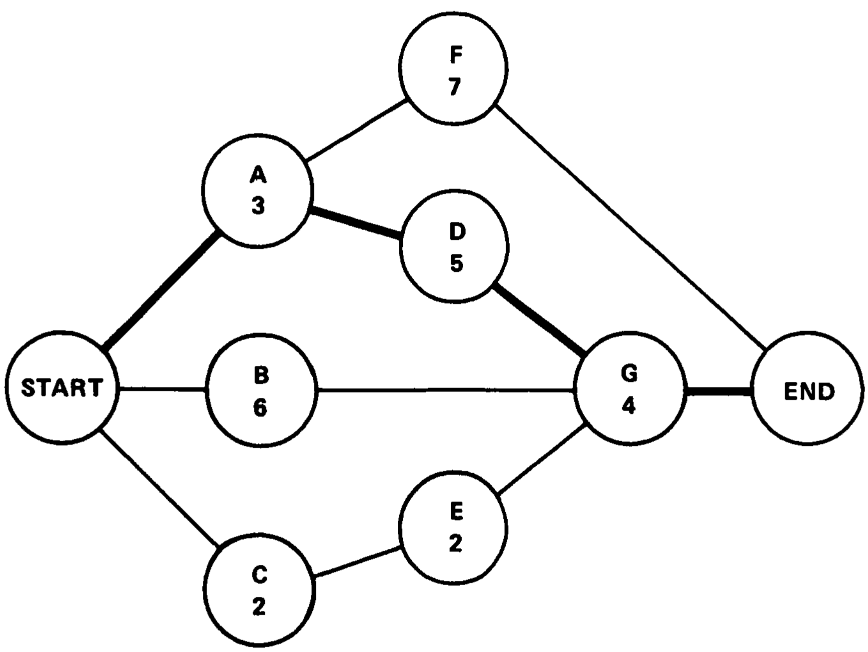


Exhibit 3: Cost Table for Remote Control Building Project

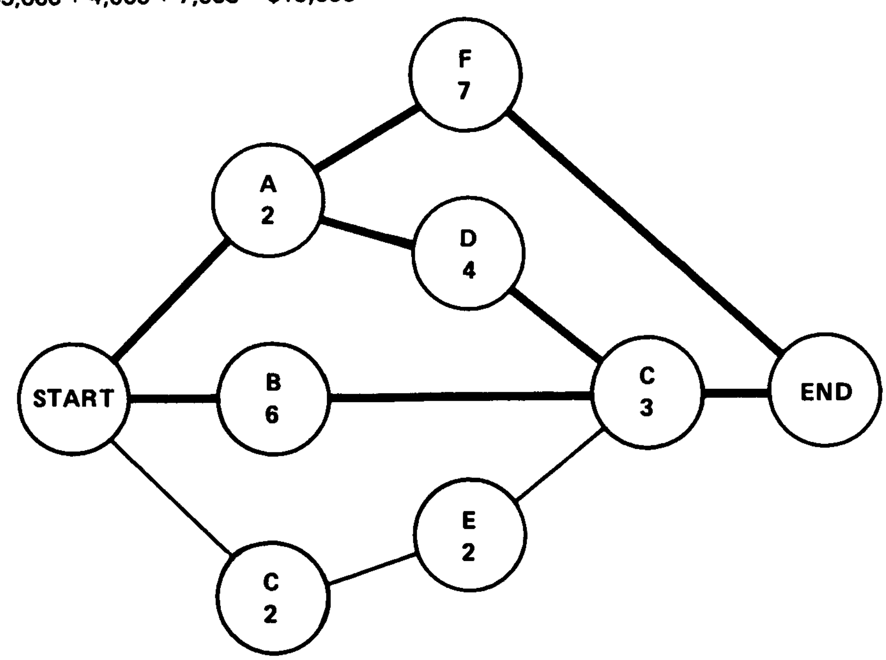
Activity	Normal Weeks	Normal Dollars	Crash* Weeks	Crash* Dollars	Cost Slope, Dollars/Week
A	3	$ 5,000	2	$ 10,000	$5,000**
B	6	14,000	4	26,000	6,000
C	2	2,500	1	5,000	2,500
D	5	10,000	3	18,000	4,000
E	2	8,000	2	8,000	——
F	7	11,500	5	17,500	3,000
G	4	10,000	2	24,000	7,000
Total		$61,000		$108,500	

*Crash weeks shown represent the minimum possible time for the given activity.

**This is the cost of gaining one week over the normal time by use of "crash" methods.

Exhibit 4: Revised Program Schedule for Remote Control Building Project

Path	Time	Additional Cost
ADG	2 + 4 + 3 = 9	$5,000 + 4,000 + 7,000 = $16,000
AF	2 + 7 = 9	
BG	6 + 3 = 9	
CEG	2 + 2 + 3 = 7	

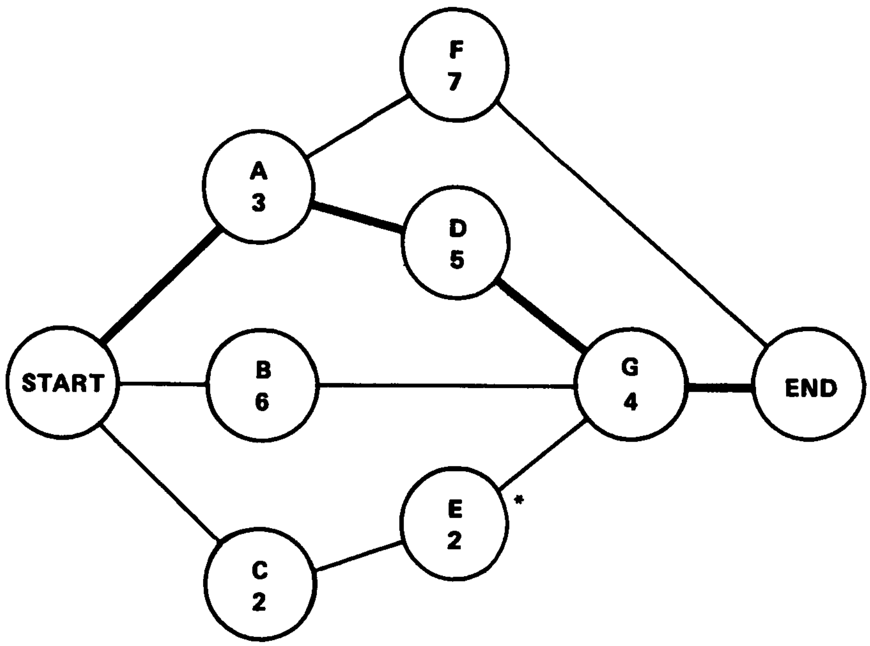


Planned Cost + Additional Cost = $61,000 + 16,000 = $77,000

Reynolds Construction Company

1 and 2. The following series of networks shows how the Reynolds Project can be shortened from twelve to seven weeks. Critical Paths are shown in heavy lines. An activity with an asterisk means it is at minimum duration.

a. Case Project Length = 12 weeks

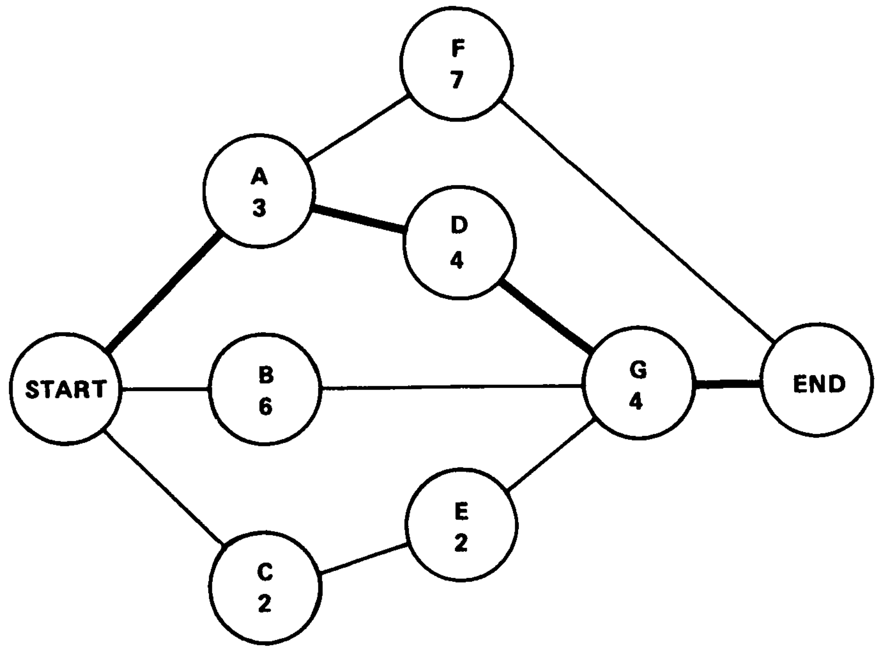


Critical Path – ADG – Total Cost = $61,000

b. Change from 12 to 11 weeks

Alternative	Action	Incremental Cost of Action
I	Reduce A by 1	$5,000
II	Reduce D by 1	4,000
III	Reduce G by 1	7,000

Best alternative II

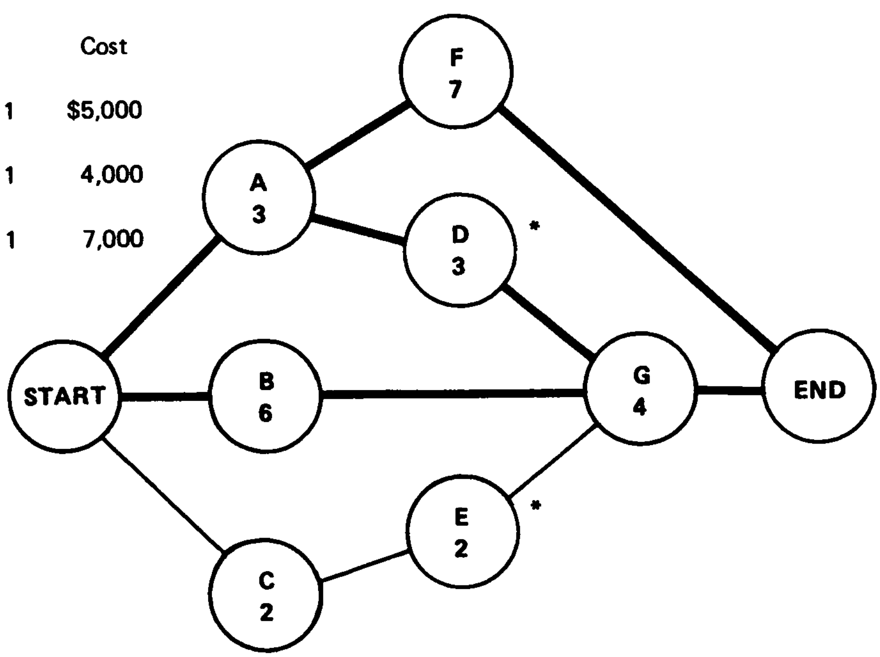


Critical Path ADG – Total Cost = \$61,000 + \$4,000 = \$65,000

c. Change from 11 to 10 weeks

Alternative	Action	Cost
I	Reduce A by 1	\$5,000
II	Reduce D by 1	4,000
III	Reduce G by 1	7,000

Best alternative II

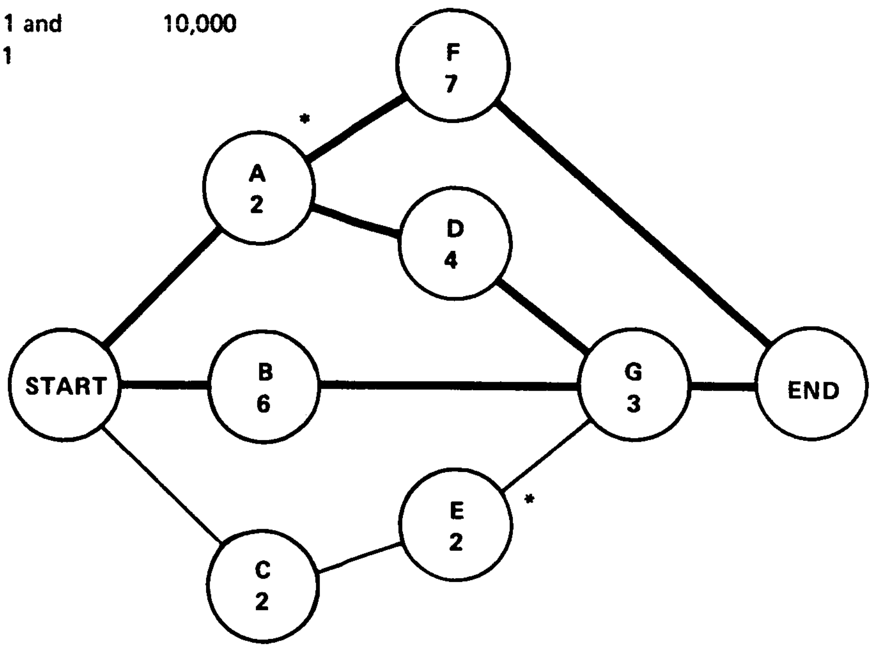


Critical Paths ADG, AF, BG
Total Cost = \$65,000 + \$4,000 = \$69,000

d. Change from 10 to 9 weeks

Alternative	Action	Cost
I	Reduce A by 1 and Reduce G by 1 and Increase D by 1	$ 8,000
II	Reduce A by 1 and Reduce B by 1	11,000
III	Reduce G by 1 and Reduce F by 1	10,000

Best Alternative I

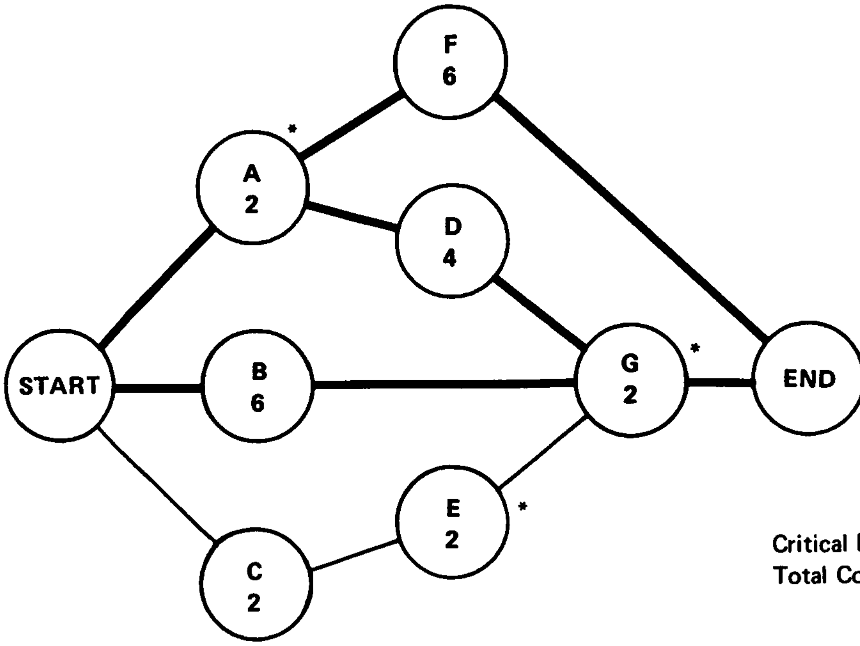


Critical Paths ADG, BG, AF
Total Cost = $69,000 + $8,000 = $77,000

e. Change from 9 to 8 weeks

Alternative	Action	Cost
I	Reduce F by 1 qnd Reduce G by 1	$10,000
II	Reduce F by 1 and Reduce B by 1 and Reduce D by 1	13,000

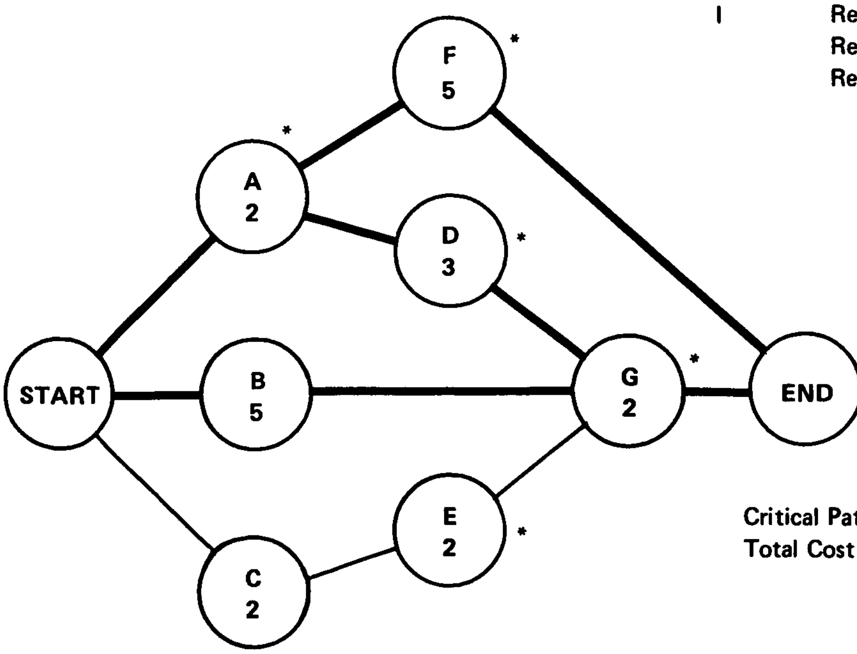
Best alternative I



Critical Paths ADG, BG, AF
Total Cost $77,000 + $10,000 = $87,000

f. Change from 8 to 7 weeks

Alternative	Action	Cost
I	Reduce F by 1 and 2 Reduce D by 1 and Reduce B by 1	$13,000



Critical Paths ADG, BG, AF
Total Cost = $87,000 + $13,000 = $100,000

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4 PROJECT MANAGEMENT

Quotations and Negotiations

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Learning Objectives

QUOTATIONS AND NEGOTIATIONS

After finishing this chapter, you should be able to:

- Describe the central role of the customer in determining the nature of the project, including its quality controls.
- Describe the two principal types of contracts and their implications for the administration of the project.
- Outline and explain the components of a quotation.
- Explain the value of negotiations in finalizing contracts and establishing strong business relationships.
- Describe the benefits of in-contract service.

Contract Specifications and the Customer

Key Term

Specifications

1. Statements of particulars.

2. Detailed accounts of such contract items as quality and performance.

The varieties of customer control range from informal and indirect to formal and direct.

The customer determines the kind and the nature of the product and process controls imposed on a project. While the economics of these controls may be largely fixed by the value and use of the product, they do exist in every case. A commercial company producing lawn furniture has a less formalized quality control system than a manufacturer of computers, but even the furniture manufacturing system will not tolerate the assembly of many defective seat cushions without initiating corrective action. If too many defectives are assembled and offered for sale, it will not be long before sales begin to be affected because of the customer's reluctance to buy. There exists a similar situation in the design, financing, and operations areas of the organization. A design that produces a poorly functioning product, financing that barely covers the carrying costs of accounts receivable, or operations that are slipshod and uneconomical in the long run also demand corrective actions.

The constraints become more formal when dealing with an industrial customer. In this instance, the product is more closely governed by a definitive purchase order that may indicate application, environment, and expected service life in addition to other specialized parameters. Because of increased product value or criticality of use, the customer relies less on repeat orders to enforce his wishes. He spends more time and money to outline specifically the things he expects the product to do. A boiler feed-water pump cannot be easily replaced and is critical enough when installed for the customer to delegate one of his procurement engineers to the task of working with potential vendors on design, cost, and quality levels prior to even issuing a purchase order.

Government and defense contracts: a special case

When the customer is either the government or a large defense contractor, he will extend his product definition as far as he feels it necessary to ensure that he gets what he wants, when he wants it. Since the product may range from space capsules through whole oil refineries to artillery ammunition, it is too critical and too expensive to wait for feedback data from the user to the manufacturer to fix it. It must be right the first time. The customer will therefore expend his efforts in a definition of that rightness and willingly enter into a closer relationship with his supplier to achieve that "rightness."

Instead of the tenuous (but quite real) unwritten restrictions of the open market, industrial and defense manufacturers are given product specifications as definite contractual obligations. The recognition that these obligations must be satisfied is one of the most important of managerial responsibilities. Without customer-directed written specifications for compliance, the commercial project manager, after consultation with his marketing sales group, should set up his own documented project specifications. In every case, written customer specifications should be followed. The customer is an equal partner in this project of design, build, and ship, and he should not be considered a passive partner. Changes and improvements may originate from his personnel as well as the manufacturer's personnel, and a constant awareness of his needs is always necessary.

Reviewing Quiz

Now that we have examined the range of customer control, cross out from the following list any customer who would have no control over project specifications.

- ☐ Buyer of razor blades
- ☐ U.S. Department of Defense
- ☐ Large industrial-machinery purchaser

Fill in the preceding boxes with numbers to rank the remaining kinds of customers in order, from the kind who generally exerts the least formal control over project specifications (number 1) to the kind who generally exerts the most formal control (the higher or highest number).

Your Dry-Run Project

Extend your understanding of the range of customer control still further by answering the following questions about your dry-run projects.

1. Who would be the customer involved in your dry-run project?

____

2. What means of control would this customer be likely to have over your project? (For example, would his inspectors be on hand at various points in the acquisition phase?)

____

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3. Would these means of control create any problems for you as project manager? What kinds of problems? (For example, would you need extra personnel to deal with the customer's inspectors? Would you need an additional person to generate data for the customer to examine?)

Re-evaluate this answer after reading the following text.

____

____

____

____

____

Reviewing Quiz — You should not have crossed out any of the items. 1 3 2

The Two Principal Types of Contracts

For a further discussion of contract types, see Contracts, *Educational Memo, General Precision Inc., Little Falls, N.J., Ainard Gelbord, Nov. 14, 1962*

There are two principal types of contracts: Fixed price and cost. The major difference between the two is the seller's obligation.

- In a *fixed price contract*, the contractor must perform the agreed-on services or furnish the required supplies for the price established by the contract.

- In a *cost contract*, the contractor agrees only to use his best efforts to fulfill the contract within the amount estimated in the contract but has no obligation for further performance unless the customer increases the funds.

Would these considerations apply to your dry-run project?

In deciding upon the type of contract, the major consideration is whether at the time the contract is signed the item can be made or services performed. A subsidiary consideration is the degree of customer audit and consequent seller administration needed to segregate adequately all applicable costs in a cost contract. Unless the seller's accounting procedures lend themselves to complete and clear cost segregation before the contract is obtained, the acceptance of a cost contract would result in higher administrative overheads and might become an overrun-causing factor due to the necessity of installing such a cost-control system.

Reviewing Quiz

Draw lines to indicate whether the statement on the right refers primarily to fixed price contracts or cost contracts.

1. The contractor agrees only to use his best efforts to fulfill the contract within the amount estimated in the contract.	a. Fixed price contracts
2. The seller is sure he can make the product or provide the service within the specified time and for the specified amount.	b. Cost contracts

Reviewing Quiz 1. b 2. a

Comparison of Types of Government Contracts

Contract type	Definition	When used	Risk factor	Audit
Fixed price	Agreement to furnish designated supplies or services at a specified price which is not subject to adjustment based on performance tests.	Where reasonably definite specifications are available and cost can be predicted with reasonable certainty.	Greatest risk. Greatest possibility of profit or loss.	Minimum audit. Examination of records clause. (In procurements over $100,000.) Certificate of current pricing. Price reduction for defective pricing clause.
Fixed price redeterminable. Limited by Armed Services Procurement Regulations to R & D contracts over $100,000.	A form of contract whereby the parties, in light of actual cost experience gained during partial production of the contract items, can re-evaluate the reasonableness or price originally negotiated.	Estimates of material, labor, and firm specifications not initially available. Sound initial estimates of cost of performance cannot be made.	Reduces contingencies included by seller in his original quotation. Reduces contractor's incentive to reduce costs until price is established.	Satisfactory accounting system and complete records mandatory. Periodic cost statements required and complete audit necessary. Unit costs segregated. Examination of records. Certificate of current pricing. Price reduction for defective pricing clause.
Fixed price incentive	Fixed price contract with provisions for adjustment of total target profit and establishment of final contract by formula based on relationship which final neaotiated costs	Requirements for contract must be firm. Contract should be for substantial sum and have long enough production period for seller to develop and practice economy.	Incentive to seller to reduce costs. Buyer shares in cost saving. Risk is shared by buyer and seller.	After performance of contract, final cost negotiated in accordance with formula. Examination of records. Certificate of current pricing. Price reduction for defective pricing clause.

Comparison of Types of Government Contracts

Contract type	Definition	When used	Risk factor	Audit
Cost plus fixed fee	Cost reimbursement type contract which provides fixed fee which does not vary with actual costs unless scope of work is changed. Seller receives allowable costs. Where there is no valid basis for estimating cost of performance.	Limited to research and studies by ASPR.	Minimum risk on contractor. Fee limited to 10% for experimental and development or research work and and 7% on any other contract. With secretarial approval, limitation may be increased to 15% and 10% respectively. Best efforts only.	Most difficult to administer. Records clause: complete audit permitted, including raw, in process, and finished material inventory. Seller must maintain record of cost incurred and notify buyer when costs have reached 85% for supply and 75% R&D contracts. Certificate of current pricing.
Cost plus incentive	Cost reimbursement contract with provision for fee which is adjusted by formula in accordance with relationship which total allowable cost bears to target cost.	If procurement involves reasonably long performance period and there is substantial amount of development work.	Increases the risk of contractor as he may lose fee if costs exceed target. Contractor can get increased fee if costs are less than target cost. Risk is shared.	Same as CPFF.
Cost sharing	Cost reimbursement contract in which contractor receives no fee but is reimbursed for agreed portion of allowable cost.	Where contractor will benefit substantially from performance. RAD where results may have commercial application.	Risk is shared according to agreement.	Same as CPFF.
Time and material	Procurement on the basis of (1) direct labor hours at specified fixed hourly rates and (2) material costs.	(1) Repair maintenance, or overhaul work; (2) engineering design and manufacture of special machine tools; (3) emergency situations.	Minimum risk. Particular care must be executed by buyer since this type of contract does not encourage efficiency.	Adequate controls, including appropriate surveillance by buyer, are required during performance. Same as CPFF.

Quotations and Their Management

Key Term

Quotation

A formal statement, prepared by a contractor for his customer, that includes cost estimates, specifications, and other key information about an agreement between the two parties.

Focusing Quiz

Indicate whether you think the following statements are true (T) or false (F). In answering, consider what you already know about the principles of project management, as well as what you have just read in the above definition.

1. The components of a quotation are prepared by the section managers and other subordinates of the project manager.

2. The project manager lays out the over-all scheme of a quotation.

3. Responsibility for preparing quotes for specific tasks should be given to the people who will have responsibility for the sucessful completion of those tasks.

In some ways, the preparation of a quotation is like the preparation of a blueprint.

Technically trained personnel are similar to management personnel since they are mainly required to operate in the future. Their forte is the ability to predict an occurrence with a fair degree of exactness before it happens. Experimentation and observation are guides to a behavior pattern which, if repeated often enough, can be extrapolated. With a knowledge of mathematics, materials, and environment, a civil engineer can project the fabrication and assembly of steel in such a manner that the resulting structure will stand. In this context, the quotation is similar to the structural blueprint and should be developed by the seller as the blueprint is developed by the civil engineer. The quotation is a forecast of some type of profit plan.

Focusing Quiz — All three statements are true.

How to prepare a quotation

The over-all scheme of a quotation should be laid out by the project manager. The quote components are broken into smaller sections and handled as detail prints are handled by the draftsman, but with one important difference; the draftsman/designer designs the details after coordinating them with vendors and shop personnel. He is not directly involved in manufacturing the pieces he designs. On the other hand, the person responsible for generating a section of a quotation is the same person who will supervise the completion of the quoted task.

The quotation should be broken down in components that are understandable and manageable for the people who are to do the work. In general terms, these components include the following:

The seller's answer to the customer's work statement (proposal)
Schedules
Contract type
Specifications and documentation
Cost estimates (and their derivation)
Terms and conditions
Final desired profit position, usually defined by a price

The seller's proposal

Depending on the complexity of the customer's requirements, the *seller's proposal* section may be quite brief or extremely detailed. A response to every customer requirement is needed or else the seller must obtain the customer's concurrence to a change. In some cases, such as defense contracts, the seller's engineers may come up with technical questions not explained in the scope of work. If these questions are of major concern, a bidder's conference is often held, where all of the seller's questions and the customer's answers are given simultaneously to all prospective sellers. The major procedure to be followed in the proposal is a paragraph by paragraph check-off of the buyer's scope of work against the seller's proposal.

At this point you may wish to refer back to the discussion of project plan delineation in Chapter 3.

When the seller answers the question "what is wanted" he may proceed to the other questions of "how," "why," "where," and even "who." The extent of the proposal is limited only by the customer's request for information. "Brochuresmanship," defined as the art of making overextensive and profuse manuals, written sales pitches, or grandiose claims to success, should be guarded against at the project level. Brevity is an asset now. The customer's technical people will evaluate the proposal and would probably react unfavorably to excessive journalism.

Incident

The Bushman Medical Instruments Company: fitting the seller's proposal to the customer's requirements

As you read the following incident, consider what you have just read about the customer's interests.

The Bushman Medical Instruments Company had recently received a request for a bid to develop some patient-care monitoring devices for use at the New England Medical Clinic. Jim Bushman, the president's son, had been assigned as project leader for preparing the company proposal. Jim had been excited about this because he had spent some time examining the marketing opportunities for new patient-care systems and had been impressed by the wide range of new ideas in that field. In developing his proposal, he was able to include many of the latest techniques and technologies and to provide a system that represented the state of the art in electronic patient-care support. Thus, he was most enthusiastic about the prospects and thought that the company was a "shoo-in" to get this project.

Unfortunately, the New England Medical Clinic did not react favorably to the Bushman proposal. The senior doctor at the Medical Clinic felt that because their patients tended to be older and more conservative, that a fairly low-key system was called for. In fact, he thought that patients should not see directly any new-fangled pieces of equipment or that they should not have to learn new approaches for doing things such as calling a nurse or for having diagnostic work done while at the clinic.

The New England Medical Clinic had a reputation for practicing excellent medicine, but they did not have a reputation for innovation. Because of Bushman Medical Instruments' strong reputation, the director of the clinic asked Jim if he might want to revise his proposal before the final contract award.

Why was the reaction of the clinic so different from what Jim expected? If you were Jim, would you revise your proposal? If so, how?

See response at the bottom of page 12

The schedules section of the quotation

The contract-type section

Specifications

Now that we have considered the general purpose of the seller's proposal and the need to fit with customer requirements, we can take a closer look at some of its more specific features.

The *schedules* section would include a delivery rate, possibly an expenditure rate, and/or a manpower loading which would determine future capability to supply. It is carefully evaluated by the buyer's management personnel, for it is a prime indication of the seller's capacity and planning capabilities.

The *contract* section would discuss the contract type. Whether it is a cost type or a fixed price type depends primarily on the product to be delivered or the service to be rendered. The greater the unknown factors become, the greater the tendency to move in the direction of a cost-type contract.

The content of the *specifications* section would also depend on the product or service. As mentioned before, industrial and defense contracts are specified rather completely. A consumer-product oriented company should set up consumer specifications from the data they already have or can gather from the marketing department and use these specifications as though they had been formally imposed by the customer. Without a base line against which to compare performance, there can be no control.

Focusing Quiz

Draw a circle around each statement that you feel suggests the approach that should be taken in the preparation of the next section of the quotation: the cost-estimate section. In completing this exercise, apply what you have already learned about the principles of project management.

1. The project manager reviews the whole cost estimate.

2. The section managers coordinate the cost-estimate preparations of various groups within their sections.

Incident

Clearly the main problem in this situation is that the project leader, Jim Bushman, did not understand the customer's requirements and environment when making the proposal. Rather, he chose simply to present his *own* ideas, while overlooking those of the prospective customer. If Jim desires to obtain this contract, he should certainly revise his proposal. That proposal should then emphasize the ideas most important to the New England Medical Clinic and deemphasize those suggestions that would be considered unimportant or would detract from the proposal. Additionally, Jim needs to make sure that the Bushman Medical Instruments product will in fact fit with the needs of the customer.

3. The section managers have nothing to do with the preparation of cost estimates.

4. From the time the cost-estimate preparations are begun until the time they are completed, the project manager is constantly evaluating the process.

Cost estimates and their derivations

For more on cost estimates, read Project Estimating by Engineering Methods, *Gallagher, Hayden Publishing Co., New York, 1965.*

The detailed preparation of cost estimates should be delegated to the groups or individuals who will be most responsible for doing the job when the contract arrives. Breaking the entire requirement into logical "pieces" also enables the seller more easily to understand the scope of each piece and how it fits into the whole quotation. The engineering piece, for example, may be further broken down within the engineering group into sections such as layout, detailing, production support, test writing, and customer technical liaison. Theoretically, this section is first coordinated by the project engineer and then coordinated with other sections such as quality and production contracts into a whole by the estimator. A major job for the project manager is the review of the whole quotation. He should, however, constantly analyze the entire quoting process and compare against prior similar jobs to uncover errors before they are masked by being assembled into the whole quotation.

The detail information required in quoting falls into three general categories:

Buy

Make

Support

Information about what to buy

The materials list falls into the buy category. This list should include the material, finishes, and outside services to be contracted for. In addition to information about what is wanted, the manager should include information about when it is needed. He will be able to determine the when from the plan. If he is using Line-of-Balance, he will be able to determine delivery requirements quite easily. Material overages must be estimated to account not only for losses due to in-process rejections but also – in some cases – to satisfy the contractual delivery schedule during the time that the defective material is being returned to the vendor for repair. The material "request for quotation," sent out to vendors, must be at least as complete in its requirements as the consequent purchase order.

Focusing Quiz

You should have circled statements 1, 2, and 4.

Incident

As you examine the following incident, consider what you have just read about buy information in a quotation.

The price sounded right to the section manager: $25 each for a part. Naturally, he included the vendor's quote in his own quotation, which the customer accepted within the allotted time – 30 days. That was when the problems began. The vendor's price had gone up to $35. He said the earlier price had only been good for three weeks.

If you were the section manager, how would you have avoided this problem?

____

____

____

____

____

Information about what to make

Cost estimates in the make category include a requirement for written operation sheets or other data describing exactly how each part will be made and what its unit time will be. The projected part delivery here is the purchasing time plus the time taken in process (not the unit manufacturing time) to finish it. The actual cost, however, is the estimated unit manufacturing time. Make costs include the costs of tooling, setting up, machining, and handling.

Your Dry-Run Project

Check your knowledge of what you would have to make and buy for your dry-run project. In the horizontal panel of the table, write one of the more involved tasks from your list on page 1-7, and then enter the point in time by which the tasks would have to be accomplished. Then, in the left-hand column list the items you know you would have to buy, in the center column the items you know you would have to make, and in the right-hand column the items you are not yet sure about.

Incident

You could have avoided the problem by insisting that the vendor quote a price he could maintain for at least the period of time it takes you to quote, negotiate, get a contract, and issue the purchase order.

You may wish to ask a project manager with experience in the area of your project to comment on your lists.

Task: ________________________ Time: __________

Buy	Make	Not sure

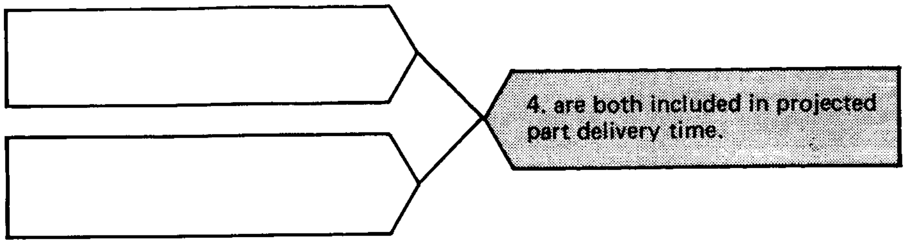
Reviewing Quiz

There are two parts to the completion of each of the following statements about the buy and make information needed in a cost estimate. Write one part in each of the two boxes attached to the statement.

1. The two basic kinds of buy information are

2. are the two reasons why material overages should be estimated on a manufacturing project.

3. Cost estimates in the make category include data describing



Quote control

It becomes more important to exercise control when the quotation sections justifications are opinions rather than when they are concrete. Material costs are relatively straightforward since they are strictly justifiable. The quotation derivation should show a vendor quotation for each part, and these parts therefore have a concrete justification. Less straightforward are labor costs, for actual past costs are extrapolated in quoting. These past costs become the springboard from which to estimate how much a similar part will cost to make.

Are there any items in your make list that might be less expensive to buy? Are there any items in the buy list that might be less expensive to make?

Make costs, as estimated, must be justified more rigorously than other quotation sections. The mere fact that the particular part has been made in-house before does not merit accepting these costs as a valid extrapolation until other evaluations are made.

A comparison of make costs with competing outside vendors is useful in the case of direct manufacturing hours. Opinion becomes more valid, in these cases, when several independent evaluators generally agree with one another. A Gantt chart of manpower usage is helpful for those labor costs that are a function of time, such as contracts personnel. For example, we might assume that after a given production volume is reached, administration is independent of the number of items made because the administrator (or administrators) will normally work only 40 hours a week and his reports can cover the accomplishments of 1, 10, or 100 tasks by the project sections. In that case, an increment in the contract production quantity over the same time period will have no increment for those costs which are time based and are defined as direct support costs.

Reviewing Quiz

1. what is wanted; when it is wanted 2. to account for losses due to in-process rejections; to compensate for defective material that the vendor must repair or replace 3. how each unit part will be made; what its unit time will be 4. the purchasing time; the time taken in process (not the unit manufacturing time) to finish it

Support costs

Direct support costs include management, production engineering, and quality assurance. Once a project manager is assigned full time to a project, the number of units in a contract have relatively little effect upon his efforts and no additional management is required. These support costs may be treated similarly to set up costs; they are fixed and as the number of units increases the unit cost decreases.

In some management positions, such as foreman and others who handle groups of employees, a minor increase in contract production quantity may result in a great increase in contract costs. This may occur when more employees than the usual number supervised by a foreman arc hired. Another foreman is needed even though the additional crew is not fully manned. In many cases, however, overheads, taken as functions of direct labor, include this supervision and obviate the problem. The main point is that quotation backup data must be realistic and thoroughly analyzed both for completeness and validity.

Reviewing Quiz

As a project manager, then, you will have to watch some costs more carefully than others. Examine each of the following pairs of costs carefully. Then shade in the box containing the less predictable cost – the cost that will have to be more carefully controlled.

1.
- a. material costs
- b. labor costs

2.
- a. management support costs
- b. make or buy costs

3.
- a. cost estimates based on one opinion
- b. cost estimates based on five opinions

The terms-and-conditions section of the quotation

Among kinds of items that should be covered in the terms-and-conditions section of the quotation are the following:

✓ Fob point.

✓ Point of inspection (customer's installation or your plant).

✓ Patent indemnity.

Reviewing Quiz 1. b 2. b 3. a

- ✓ Cost reimbursement formulas and contract type.
- ✓ Warranty clauses.
- ✓ Changes clauses (how to handle a change in the scope of the contract).
- ✓ Reports supplied.

> Many other kinds of items may also be included in the terms-and-conditions section of the quote. The criterion for their inclusion may be that they directly affect the price of the project. Or, it may be that they indirectly outline other responsibilities which both the seller and the customer must satisfy. Information on this last point could be as vitally important to the project as the price itself.

Some final considerations

A quotation, then, includes many things besides a dollar figure. It is, in fact, a complete package of constraints, descriptions, and plans for the satisfaction of customer needs. The dollar figure is then just one factor in the proposal. In some cases it may not even be the most important factor. The buyer may be concerned primarily with the seller's ability to engineer a complicated control device; therefore, the seller's proposed outline drawing and consequent delivery schedule may be of paramount importance. The nature of the customer and his needs, the product supplied, and the seller's plans for supplying the customer's needs should therefore be considered in the same manner as all the other sections of the quotation. Price may be secondary.

PERT Diagrams and Quotations

Each seller organization will probably have its own internal quoting procedures designed to satisfy normal business needs. In many cases, when the quotation task is fairly large, it is possible to lay out a PERT diagram for the quotation. This diagram will forecast the quotation task itself. It should also be possible to set up standard networks for quotation pieces and assemble the networks as required by the customer's request for proposal.

There is no time estimate for such quotation needs. That can be established during a preliminary quotation review and section assignment meeting. It is dependent on the customer's requirements and the quotation workload of the quality group.

Incident

As you examine the following incident, consider what you have just read about standardizing networks.

A new manager of project management had been appointed — a man who prided himself on his efficiency. One of his first steps was to look for ways to cut down on the amount of time it took to come up with quotations for his organization's projects. Insofar as possible, he wanted to systemize this process.

Investigating the quality control procedures of past projects, he consistently found the following events:

a. Go ahead.

b. Complete comparison of present quality control plans with customer's requirements.

c. Complete qualification test plan.

d. Complete reliability plan.

e. Complete changes of quality control plan.

f. Document in-process quality control unit costs.

g. Cost out qualification test.

h. Cost out reliability.

i. Cost out quality assurance.

j. Cost for management review.

He also found that the following were common relationships among these events:

b, c, and d could be worked toward independently.

d and g were necessary preparations for h.

g, h, and f were necessary preparations for i.

f, g, and i were necessary preparations for j.

With this information, he wanted to prepare a quality control quotation network. Suppose he assigned this task to you. Work out the appropriate PERT diagram in the space on the next page.

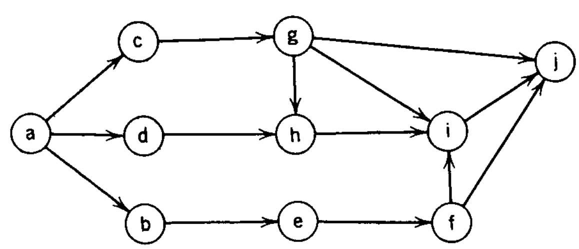
Negotiating the Contract

Key Term

Negotiation

An interaction between two or more parties for the purpose of coming to terms on some specified matter.

Incident



Focusing Quiz

Check the box before each of the following kinds of customers with whom a project manager would be likely to formally negotiate a contract.

☐ 1. A purchaser of specially designed industrial machinery

☐ 2. A purchaser of an oil refinery

☐ 3. A roller-skate wholesaler

When negotiations are more likely to occur

The quotation has now been sent out to the buyer, and he states that he wishes to negotiate a contract. This is less likely to happen with consumer goods than with industrial or defense products because the market place is greater in the consumer-goods field. In effect, competition is the negotiating force. The buyer, in the case of consumer goods, is able to compare the quality, price, and delivery schedules of many items similar to those in the quotation. He can therefore determine quite easily if the quotation is the best one available to him.

The least free-market situation occurs in defense or major industrial contracting when the product is a single-source item. The purchaser must therefore deal only with the single-source manufacturer because that is the only supplier of his needs and in all probability has designed the single-source product specifically for the buyer's application. Thus both buyer and seller are to all intents and purposes, locked together. This situation has analogies in capital goods industries where suppliers often design and build a single product to a customer's specifications. This product may be anything from a special fixture to a complete oil refinery. Why then negotiate? The customer has the quotation, apparently at the lowest price, and even if the seller is not a single-source supplier, good business relationships cannot be built at a bargaining table. Or can they?

Why negotiation is useful — even in the case of a single source item

The answer is — Yes they can, and in fact, when developed that way, business relationships are often stronger. The negotiation is not strictly confined to a price analysis. It investigates and tries to clarify every aspect of a potential contract as outlined by the quotation. Very few people look at the same thing with the same viewpoint. The buyer, for example, may have requested a monthly in-process quality level report, but when he is told what such a report will cost, he may decide (depending on his previous evaluation of its worth) to expand, contract, or even drop his requirement for this report. He may have been planning on a simple single-sheet report per month whereas the seller may be quoting on a cumulative historical monthly booklet.

Focusing Quiz

You should have checked the boxes before items 1 and 2. The text explains why.

> The primary purpose of a negotiation is to clarify and identify completely, to the satisfaction of both parties, the scope of the work to be done. Secondary aspects include the elimination of arithmetical and descriptive errors and the establishment of rapport between buyer and seller. This rapport can become very important in some cases.

The determinants of value

The value of a buyer-specified task has no absolute measurement except in an area of complete competition. When many sellers are ready to deliver roller skates at $1.00 a pair, the buyer realizes that the market-directed value measurement of skates is $1.00, and it is the same for anyone who wants skates. If competition decreases and if theoretically it were possible that the buyer were the only one who wanted the skates, the value (or cost) of the skates would be a function of the negotiation of a contract for someone to make and deliver them. Because no competition would be involved, the buyer would have to specify everything he wanted concerning the skates.

Analyzing Quiz

In the space provided, evaluate the project manager's attitude toward the following negotiations. Discuss the limitations of his stance.

The negotiators: The manufacturer of a complex single-source item and a nervous customer

The project manager's attitude: "Let's just finalize the price and get out."

Evaluation:

____

____

____

____

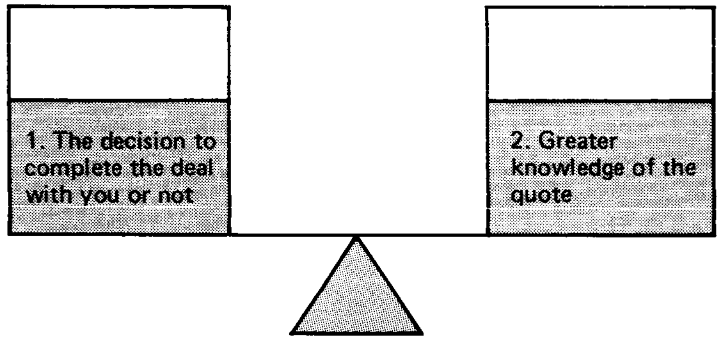
____

Analyzing Quiz

In your evaluation, you should have mentioned the importance of gaining the confidence of the nervous customer. You should also have mentioned that negotiating sessions for complex systems provide an excellent opportunity for eliminating errors and clarifying ambiguities in the quotation.

Focusing Quiz

The buyer and the seller each have a certain kind of leverage in negotiating contracts. In the blanks provided, indicate which advantage is the buyer's and which is the seller's.



Circle each quote that offers good advice to the negotiating project manager.

3. "Answer all the customer's questions directly. If you don't have an answer, say so."

4. "Let the customer control the negotiations."

5. "Direct the negotiations toward those areas where you have the most backup data."

How to negotiate when you are less than fully prepared

The buyer's main advantage in a negotiation is his final decision to buy or not to buy from the seller. However, the seller is not at a disadvantage. During the negotiation, the seller's major advantage is that he is certainly more knowledgeable about the quotation than the buyer, for he is the one who generated it. Even though he wants to sell to and satisfy his customer, he must do so at a reasonable price. With this in mind, the seller should direct the negotiation toward those areas where he has the most data as backup. Every quotation has its areas of concrete backup, such as vendor material subquotations and opinion backup in such an area as labor hours for production. If the buyer wishes to analyze the material costs, the seller should keep bringing out vendor quotations until the buyer is fully convinced that, if this area is an indication, the seller has complete and thorough cost justifications in every other quote area.

Focusing Quiz   1. the buyer   2. the seller

You should have circled item 5. The text that follows discusses these answers.

The seller should not volunteer information unless this information will steer the buyer toward the seller's strong areas. If the buyer insists on probing relatively weak areas of the quotation, there are subtle techniques to guide him toward stronger ones. For example:

- If he proceeds with logical questions on cost right down the quotation, after answering briefly, respond with random questions about the request for the proposal and the scope of the work.

- If he proceeds with random questions, after answering briefly, insist on a logical exposition of the quotation and say that you will provide additional data later. He may not remember to bring objections again, but if he does, you will probably have been able to obtain the data by that time.

How to establish customer confidence

If the project manager has done his homework before the negotiation and is completely conversant with his own proposal, the promptness and completeness of his answers to the buyer's first few questions might lead him to believe that no matter how deeply he probes, the manager will have the answer. An interesting point to consider is that if the manager has, in fact, managed the quote correctly, this opinion will probably be true.

The buyer's sources of information about the quoted product or service may vary from auditor's reports of actual costs (if he is the government and therefore has access to records) to his engineer's estimates of manufacturing costs. In general, a properly negotiated quotation with both sides fully prepared can only result in a better understanding and consequently in a better contract.

Incident

EBS Enterprises: poor preparation creates problems at the negotiating table.

In examining the following incident, consider what you have just read about the seller's main advantage in negotiations.

For several weeks, the acquisition project manager at EBS Enterprises had been holding discussions with the owners of the Elliott Knitting Mill concerning the acquisition of the mill by EBS. Negotiations had now reached the point where it was time to sit down and hammer out a purchase price and a plan for integrating the Elliott Knitting Mill with EBS Enterprises.

During the initial discussions of the price and pay-out arrangements and the integration plans, it quickly became apparent to the owners of Elliott that the acquisition project manager from EBS did not understand the knitting industry, its technology, or its constraints. Since EBS was suggesting a pay-out arrangement which would base the amount received by the Elliott owners on the future profits of the Elliott operation, this raised some real concerns in the owners' minds. It was certainly clear from the discussions with the acquisition project manager that, if he were running the mill, profits would be minimal, if they existed at all. Thus the Elliott owners had begun to push for a lump sum pay-out arrangement, even though EBS found that less attractive and would not be willing to pay as much for the operation as when based on a pay-out percentage.

In addition, the owners were concerned that the integration plan roughed out by the acquisition project manager did not give proper consideration to security for the employees at Elliott. The project manager claimed all those agreements could be worked out later on, but the Elliott owners were reluctant to make agreements at the present time if they did not understand what the later terms would be.

What has the acquisition project manager failed to do in this case? What should he have done?

Incident

The acquisition project manager has failed to recognize the necessity for understanding the other party's point of view. In particular, it is necessary to recognize the objectives of the other party and the relative value that they attach to those. Finally, in any bargaining situation, one must develop a personal position of strength and respect in order to reach an agreement that will be fair to both parties.

The acquisition project manager at EBS Enterprises needs to bring with him into the negotiations a top management person from EBS who is familiar with the technology and operating requirements of the type of business owned by Elliot Knitting Mill. This would allow EBS to establish a much better position in negotiations and to gain the respect of the Elliot owners. Finally, the acquisition project manager needs to spend more time trying to understand just what the owners are seeking and what would be most attractive to them. The best outcome from a set of negotiations is an agreement that will be viewed as fair over the long term for both parties.

In-Contract Service and Information Flow

As the value of the goods and services supplied increases, it becomes more important to decrease the time lag for information flow between the buyer and the seller since the costs affected by the lag can be quite important. When the buyer recognizes this, he may station his quality or procurement personnel in the plant to assist in contract performance. Conversely, the seller may feel that a field service representative should be assigned to the buyer's plant to ensure correct product usage. In either or both cases, the cost involved should be a minor consideration when the possible benefits are weighed. Planning and corrective actions become worthless if the information coming back is garbled, untimely, or not factual.

Focusing Quiz

The following checklist may contain some bad advice about establishing information links with the buyer. In the light of what you already know about project management, read the list carefully. Cross out any suggestions you would not consider worthwhile.

✓ 1. Limit data links to specific people.

✓ 2. Document the responsibilities of each person.

✓ 3. Document the inputs of each person.

Guidelines for establishing buyer-seller information links

When either the seller or the buyer has firsthand, on-the-scene representation, the information used as a basis for decision is clearer and much more accurate. It is, however, important to formulate these information links by documenting these representatives' responsibilities and strictly limiting inputs to them. Too many people talking to one another can be worse than nobody talking at all. (Each person sees things a bit differently, and until you are familiar with the individual's bias, inputs through that individual may not mean the same to you as they do to him.) Learning a few representatives' thought processes is difficult; when there are many, it becomes impossible. By limiting data links to specific people and having their inputs documented, any inconsistencies can be minimized by cross checks. The number of people who should call on the buyer is dependent again on the project manager and the project needs. In the beginning, it might be useful for the manager to filter all correspondence through a contracts administrator (or inside salesman) alone. Telephone and conversation inputs may

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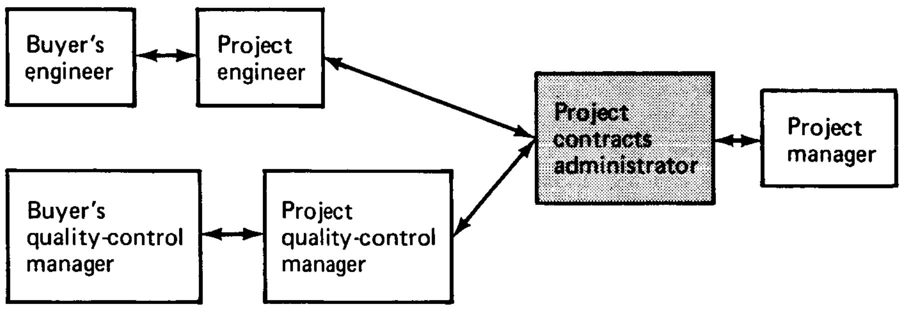
Focusing Quiz — You should not have crossed out any of the items. As the text that follows shows, all the suggestions are sound.

be encouraged, for example, on a quality-man to quality-man level or an engineer-to-engineer level, but contractual relationships should not be binding upon either party without the contracts administrator's approval. He in turn will obtain the project manager's approval. The field service people at the customer's installations will contact only the project manager. He, in turn, after evaluating the nature of the input may turn the field service representative over to engineering, production, or another project area for action, but if initial contact is always made with the project manager, he can be reasonably sure that the right people will be informed and a followup (personally, if necessary) will be made.

One kind of information linkage

The contracts administrator's approval may not be required unless the contractual relationship between the buyer and seller is involved.



The buyer-seller interface is about as important as any other part of the project, if not the most important. It would be fine if both parties agreed with each other in every respect. As a side issue, the contract itself is only a documentation of what both parties have agreed to do. The buyer is as much a part of the project as the project personnel and should be treated that way. As a matter of fact, as a project manager, you will probably have as much to do with him and his people as your own family. On the basis of sleeping eight hours a day, there are only 112 usable hours in each seven-day week. If you assume that you spend five days a week at the job and nine hours a day (including lunch and travel) with his problems, you are spending almost as much time with him (45 out of 112 hours) as with your family. Because it is doubtful that the contract can resolve and document every eventuality, there will be times when his cooperation is as important to your success in management as your family is to your success as a person. Try to act accordingly.

One point always to remember is that people distrust what they do not understand. Keep the customer informed and use his inputs. A change to an already mutually agreed on course of action may be more easily accomplished if he is informed promptly.

If the customer has not been told, for example, about a possible delivery delay as soon as you knew about it, he might not be too sympathetic when it happens, for he will not have had as much time to plan for the delay as he could have had. It is always possible that he may have an alternative solution, such as paying for overtime.

Incident

Black Diamond Coal Company: preparing a proposal for a new customer

In examining the following incident, consider all you have read about quotations and negotiations.

Bruce Russell, the president of Black Diamond Coal Company, had recently contacted Gary Polson, a senior partner of Coal Specialists, Inc., a management consulting firm, concerning some of the company's needs. Recent state laws had been passed requiring Black Diamond to install additional safety and production control procedures in the company's two major mines. Bruce was concerned about how this might best be done in order to minimize its impact on productivity and yet still meet the requirements and intent of the law. For this reason, he had called Gary and asked Gary to prepare a proposal for Coal Specialists, Inc. to examine the problem and recommend a plan of action for Black Diamond.

Gary had already taken a couple of days to examine the company's two mines, and based on his own experience and background in the coal area and on other related consulting projects, he had been able to make some rough estimates as to what would be involved in the project. He felt that the project would require approximately 30 man-days of work, with 10 of those being supplied by the engineering staff at Coal Specialists, Inc. and the other 20 being supplied by general management consulting people from CSI. While the company had several other projects going at the present time, he felt that this project could be completed within 90 days of the time it was started. However, he wasn't sure that was the best timing from the point of view of Black Diamond or from the consulting firm's point of view when future work possibilities were considered.

One of the things that Gary thought important was that while the consulting firm had substantial experience in this field, this was going to be their first engagement with Black Diamond. Gary had also determined that Black Diamond had only limited experience in the use of consultants and thus might feel somewhat reluctant to pay the \$400-\$500 a day rate normally charged for such a project. With this in mind, Gary thought it was particularly important to design his proposal so that it would help to sell Bruce and the other members of management at Black Diamond on the value that they would be receiving. Gary also realized that as an operating manager, Bruce would be most anxious to have a very specific commitment as to what would be accomplished in the project and when. With these thoughts in mind, Gary sat down to prepare a rough outline for his written proposal.

1. What should go into the proposal?

2. What would you stress in getting Black Diamond approval of the proposal?

3. What would you be willing to negotiate if Black Diamond said:

   a. Your price is too high.

   b. You are not accomplishing sufficient results.

Incident

The proposal for Black Diamond should clearly include such things as the expected benefits to Black Diamond, the requested designation of a contact officer at Black Diamond through whom CSI could coordinate their assignment, the amount of Black Diamond management time that would be required, the amount of resources to be supplied by Coal Specialists, Inc., the qualifications of the Coal Specialists people working on the project, and the time table for the project's completion. As an operating manager, the president of Black Diamond Coal Company would probably feel most comfortable if subparts of the project, for example each taking 4 or 5 days, were identified at the outset so that he could monitor the project's progress. Additionally, Gary should be forthright as to the cost of the project.

If Black Diamond indicated that the price was too high, the two alternative approaches that Gary might want to consider would be to split the project into two parts (for example, a fact-finding part and a solution part) with a provision that BD must approve the first part before the second part begins. Thus they have an opportunity to evaluate if BD is getting the benefits that CSI promised before spending more money. It would probably be a mistake for Gary to offer to do the project at a lower price than he really thought was possible. One way of overcoming a Black Diamond objection about insufficient results from the project is to outline progress points so that Black Diamond can monitor what is being done and what the value of each step is.

Summary of Chapter 4

The quotation should be a comprehensive planning blueprint of the tasks to be completed. The extent of the quotation should be determined by project complexity, size, cost, and the possible loss for not preplanning an item. However complex or simple, the quotation should be broken down into components that are understandable and manageable for the customer and for the people who are to do the work. These components include the following:

- **Seller's answer to customer's work statement**

  This section is extremely important, because the customer basically determines the kind and the nature of the product and the process controls that are imposed on the project. A response to every customer requirement is needed here. The seller must obtain the customer's concurrence with every change.

- **Schedules**

  This section includes a delivery rate, possibly an expenditure rate, and perhaps a manpower loading which would determine future capability to supply.

- **Contract type**

  This section would discuss whether the contract would be of the cost type or the fixed price type. (In a cost contract, the contractor agrees only to use his best efforts to fulfill the contract within the amount estimated in the contract. He has no obligation for further performance unless the customer increases the funds. In a fixed price contract, on the contrary, the seller must perform the agreed-on services or furnish the required supplies for the price established in the contract.)

- **Specifications**

  Specifications are detailed accounts of such contract items as quality and performance. The content of the specifications section depends on the product or service and the customer's desires.

- **Cost estimates**

  This section includes estimates and data used to establish estimates in three general categories: buy, make, and support.

- **Terms and conditions**

  Items are included in this section either because they directly affect the price of the project or because they indirectly outline other responsibilities which both the seller and the buyer must satisfy.

After examining the quotation, the potential buyer may state that he wishes to meet the seller to negotiate a contract. (This is less likely to happen with consumer goods than with industrial or defense products because the market place is greater in the consumer-goods field. There, in effect, competition is the negotiating force.) The primary purpose of a negotiation is to clarify and identify completely, to the satisfaction of both buyer and seller, the scope of the work to be done. Secondary aspects include the elimination of arithmetical and descriptive errors and the establishment of rapport between buyer and seller.

The buyer's main advantage in a negotiation is his final decision to buy or not to buy from the seller. The seller's major advantage is that he is more knowledgeable about the quotation than the buyer, for he is the one who generated it.

The buyer's influence on the project may extend from the conception and definition phases into the acquisition and operation phases. He may assign quality or procurement personnel to assist in the performance of the contract. Conversely, the seller may feel that a field service representative should be assigned to the buyer, in order to ensure correct product usage. In both cases there should be clear definitions of the responsibilities of those assigned to guarantee the flow of vital information.

Chapter 4 Progress Check

Fill in the missing word or words.

1. ______________________ are detailed accounts of such contract items as quality and performance.
2. In a ______________________ contract, the contractor must perform the agreed-on services or furnish the required supplies for the price established in the contract.
3. A ______________________ is a formal statement that is prepared by a contractor for his customer; it provides the basis for contract negotiation.
4. ______________________ costs include the costs of management, production engineering, and quality assurance.
5. ______________________ costs are less straightforward than parts costs.
6. A ______________________ is an interaction between two or more parties for the purpose of coming to terms on some specified matter.

Circle the letter before the correct answer.

7. In a cost contract, the contractor

   a. agrees to make his best effort to fulfill the contract within the amount estimated

   b. has to pay any additional costs out of his own pocket

   c. both of the above

   d. neither of the above

8. As a general rule, a consumer-goods customer exerts more direct control over project specifications than

   a. a defense customer

   b. an industrial customer

   c. both of the above

   d. neither of the above

9. The schedules section of a quotation might include

   a. delivery rate

   b. expenditure rate

   c. both of the above

   d. neither of the above

10. The cost estimate section of a quotation should include information about

    a. the estimated costs of buying materials, finishes, and outside services

    b. the estimated costs of tooling, setting up, machining, and handling

    c. both of the above

    d. neither of the above

11. Negotiations offer opportunities to

    a. solidify good relations with customers

    b. eliminate errors in the quotation

    c. both of the above

    d. neither of the above

Indicate true (T) or false (F).

12. Directly or indirectly, the customer determines the kind and nature of the product and process controls imposed on a project. ____

13. Without customer-directed written specifications for compliance, the commercial project manager should set up his own documented specifications. ____

14. Changes and improvements in project specifications may originate either with project or customer personnel. ____

15. Unless the seller's accounting procedures lend themselves to complete and clear cost segregation, he should not sign a cost contract. ____

16. The over-all scheme of a quotation should be laid out by the project manager. ____

17. The person responsible for generating a section of a quotation should be the same person who will supervise the completion of the quoted task. ____

18. In responding to the customer's work statement, the seller should not ask questions unless he is fairly sure the customer has anticipated them. ____

19. Quotations should afford the project manager an opportunity for elaborate sales pitches. ____

20. Any cost estimate of materials should account for predictable material overages. ____

Answer briefly.

21. How might the purchaser of specialized industrial equipment expert control over a project? The purchaser of a quantity of a common commercial item?

22. How might a cost contract, as opposed to a fixed price contract, affect the administration of a project?

23. What are some of the components of a quotation?

24. What is the value of negotiating when the price is fixed?

25. What is the main benefit of in-contract service?

Answers to Chapter 4 Progress Check

1. specifications
2. fixed price
3. quotation
4. direct support
5. labor
6. negotiation
7. a 8. d 9. c 10. c 11. c
12. T 13. T 14. T 15. T 16. T 17. T 18. F 19. F 20. T
21. The industrial purchaser would document all specialized parameters, such as application, environment, and expected service life. The commercial purchaser's control would be less direct. The specifications would be more or less dictated by the market. If the quality level of delivered items was too low on one order, the purchaser might be reluctant to place another order.
22. A cost contract requires the contractor to have an accounting procedure that lends itself to complete and clear cost segregation before the contract is obtained. It also requires the contractor to make allowances for the customer to audit his project.
23. Some of the components of a quotation are: the seller's proposal, schedules, contract type, specifications, cost estimates, and terms and conditions.
24. There are a number of reasons for negotiating that are not directly related to the dollar value of the contract. These include:

    the clarification and identification, to the satisfaction of both parties, of the scope of the work to be done.

    the elimination of arithmetical and descriptive errors.

    the establishment of rapport with the buyer.
25. The main benefit of in-contract service is that it provides a mechanism for decreasing the time lag for information flow between buyer and seller. This is important because costs can increase greatly when there is a lag.

Sundwall Printers, Inc.

Scott Sundwall had recently moved into the marketing area at Sundwall Printers, Inc. One of the things he was still in the process of learning about was the preparation of proposals for specific printing jobs. He had recently received a request for a proposal from the Adams Advertising Agency. The job involved the printing of recipes on each side of a single sheet of paper which subsequently would be folded in half and packaged with a food product. Scott had completed the company's standard proposal form as shown on the next page. (A copy of the standard terms printed on the back of the proposal are also shown.) Read the proposal and then complete the assignment.

Assignment

How complete is this proposal? (Be specific.) What are its strengths and weaknesses?

As a customer, what additional items would you like to have included?

As a salesman, does this proposal say everything that you would want to say?

Sundwall Printers, Inc.
1932 State Street
Phoenix, Arizona

January 15, 1976
Dial 359-7607 for dependable service

A PROPOSAL FOR	Adams Advertising 23 Sutton Square Phoenix, Arizona Attn: Steve Smith
Description	5 Recipes
Quantity	50,000 - 75,000 - 100,000 of each recipe
Pages	2 (printed both sides)
Trim Size	5'' X 6''
Paper: Body	35# Vegetable Parchment
Cover	None
Inserts	None
Artwork	To be supplied by Adams
Typesetting	To be supplied by Adams (Alterations to be charged as extra.)
Colors	- - -
Color Process	1 Color (red)
Press Work and Proofs	Blueprint proof by Sundwall - 2 weeks following receipt of job Highest quality lithography by WLC Final delivery 1 week following return of proof
Binding	Fold to 3 X 5, count, wrap in 1000's, box
Shipping	☐ F.O.B. our plant ☒ F.O.B. destination Adams Agency

Prices

Total Price	50,000 ea. of five recipes	75,000 ea. of five recipes	100,000 ea. of five recipes
Total Price	$2296.	$3188.	$3983.
Unit Price	$.0092	$.0085	$.008

Rerun Price — Deduct $320 from each of the above total prices.

Terms	☐ 1/3 on order 1/3 on blue print & color key delivery 1/3 on completed job delivery ☒ Net 30 days This price will be honored for 45 days. (until Feb. 28)
Taxes	State Sales Tax ☒ For Resale: Permit No. 7315 Agency Commission No (Prices are Net)

The above prices are based on our present costs of labor and materials. Due to unsettled conditions prevailing in the labor and material markets, all quoted prices are subject to revision to cover adjustments occurring prior to delivery of the order. An acceptance of this proposal, within 30 days and subject to conditions on reverse side of this sheet, shall constitute a contract between us.

Accepted ______________________________ , 19_____ Sundwall Printers Inc.

Client ______________________________

TERMS AND CONDITIONS

A variation of not more than (10) per cent over or under the quantity ordered shall constitute compliance with the order. The price shall be adjusted for variations in accordance with the per unit rate.

Unless otherwise specified in writing, all prices are net and F.O.B. 1932 State Street, Phoenix, Arizona.

Unless otherwise specified in writing, terms are net cash upon completion of the order. An open account shall be considered past due and delinquent if not paid in full within thirty (30) days after delivery. Interest will be charged on past due accounts at the rate of six (6) per cent per annum. Discounts to advertising agencies will not be allowed on delinquent accounts.

No claims of any nature shall be allowed unless presented in writing by Buyer to Seller within five (5) days after delivery.

Unless otherwise specified in writing, this order is for the delivery of purchased lithographed copies only. All artwork, photographs, type, paper, ink, films, plates, dies, binding, etc., not supplied by customer but used to produce this perchandise or service, shall remain in the possession of the seller. The title thereto shall convey to the purchaser on complete payment of the invoice. Said materials in possession of the seller and any other materials left with him by the buyer for storage shall be preserved with reasonable care for a period of ninety (90) days after date of invoice. The seller, at his option, may destroy or dispose of same thereafter as he sees fit without obligation to the buyer and any compensation received shall be consideration for the storage provided above.

All orders are accepted subject to failure or delay in delivery directly or indirectly caused by strikes, lockouts, or other labor disturbances, war, insurrection, riots, car shortages, accidents at the plant, embargos, fires, floods, storms, or other causes or circumstances beyond the control of Seller.

Time is not of the essence under this purchase agreement unless specifically so provided in writing.

Shipment dates stated on this Acknowledgment are approximate, and in addition are subject to Buyer's prompt delivery or return to Seller of the following: this acknowledgment duly signed; items to be furnished by Buyer; proofs approved in writing by Buyer.

Unless otherwise specified in writing, work under this order will be done during regular working hours of regular working days. If "overtime", holiday or Sunday work is required, Buyer shall pay as an extra charge the difference in cost thereof over regular time work, plus fifteen (15) per cent for supervision.

"Author's Corrections", meaning changes from original copy or specifications after all or part of work is completed, necessitating additional work, shall be charged for extra, at current rates.

Goods invoiced and held subject to Buyer's instructions shall be at Buyer's risk.

Buyer assumes all responsibility for liability in case of infringement of copyrights, patents, etc.

A charge of ten (10) per cent of the value of all paper stock furnished by Buyer will be made for handling and care of same.

If it becomes necessary to employ legal or other services to obtain payment of any account, when past due, Buyer agrees to pay reasonable charges for the same plus court and other costs, in addition to the amount of the account, and interest from the time the account becomes delinquent.

Where not otherwise specified, the trade customs of the lithographic industry shall prevail.

This order is not subject to cancellation, except by written consent of the parties.

Solution: Sundwall Printers, Inc.

This proposal is, in fact, a very complete one. Its strengths are that it indicates the specific content of the product, the dates for which the prices hold, the delivery time as well as prices for various quantities, and rerun option. Additionally, the "Terms and Conditions" notice indicates the general set of terms in the event that the Adams Advertising Agency is a new customer.

A couple of possible weaknesses are that it does not spell out in complete detail all of the inputs to the product. If Adams is a new customer, a salesman may want to cover these or possibly make them part of the proposal. Therefore, there should be some kind of customer credit approval in the proposal. Additionally, a salesman would probably like to have the proposal do more selling as well as stating the facts of the situation and the proposed contract. Finally, the customer might like to see more detail as to the support to be received from the sales and service people at the printing company and also a better definition of the quality that is to be supplied on this work.

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5 PROJECT MANAGEMENT

Beginning Operations: Trouble Avoidance

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BEGINNING OPERATIONS: TROUBLE AVOIDANCE

Learning Objectives

After finishing this chapter, you should be able to:

- Contrast the project manager's role in the conception and definition phases with his role in the acquisition phase.
- Apply a step-by-step approach to decision making.
- Analyze your own organization to discover how you should go about creating an image of yourself favorable enough that your decisions will be heard and respected just because they are your decisions.
- Discuss procedures for achieving up-the-line, across-the-line, and down-the-line cooperation.

The Value of a Project Manager in Beginning Operations

At this point in the project, the manager may feel confident that he has accounted for most of the potential danger areas. The power flow has been established; the organization has been selected and is operating well; the planning seems flawless; the quotation has been accepted; the customer has developed great confidence in his ability. Then why should there be any further need for the manager's services?

Focusing Quiz

Circle each of the following statements that accurately suggests the function of a project manager once his project has begun.

1. Once the project manager has eliminated all the unknowns by superior staffing and planning, he should not be needed.

2. The project manager only needs to keep one eye on a computer, which can receive all the essential data and put out all the necessary directions.

3. Once operations have begun, the project manager's job changes considerably. Setting up and establishing a project is a relatively

straightforward, supportive logical procedure. In contrast to this, the day-to-day solution of unforeseen problems requires exceptional management skills that are directive.

4. Now the project manager must combine the scientific tools he used in planning with the highly individualistic style that he develops to make sound decisions with incomplete data.

Incident

Constructing a new hospital: a problem in role transition

As you examine the following incident, consider what you have just read about the difference between the project manager's role in the conception and definition phases and his role in the acquisition phase.

Phil Sirlin had recently completed a set of plans for the new hospital to be located adjacent to the Southern State Medical School. As an architect with ADL, Phil had been assigned responsibility for coordinating this project, both in the design and construction phases. The Board of Directors of the hospital had hired a general contractor to actually do the construction and Phil had already begun working with him.

How to transform good will into working cooperation?

Phil's plan included PERT diagrams and other types of graphical representations for the project. So far, all of the architectural work had been completed, and he was now faced with getting into the actual construction. One of the things that Phil was uncertain about was how the transition from the planning phase to the construction phase could best be handled. The general contractor had indicated his willingness to work closely with Phil and with other members of ADL in order to have the building completed on time and according to the specifications of the customer. Phil, however, was unclear as to how much freedom he should allow the general contractor and how closely he should monitor progress on the building. He, of course, wanted to be careful not to make the general contractor feel that Phil was his boss; rather, he wanted the general contractor to feel that working closely with Phil and supporting him was best for all concerned.

Focusing Quiz

You should not have circled statements 1 or 2; no matter how carefully a project manager plans, he cannot be sure he has eliminated all unknowns.

You should have circled statements 3 and 4; unless he is skilled at the plain politics of working with people, the project manager will find it difficult, if not impossible, to manage operations.

1. What advice would you give Phil in planning his role as project coordinator now that construction is about to begin?

2. What rules would you recommend that Phil follow in executing his role at this point? How do those rules differ from those applied in his role in the design and planning phase?

Incident

One of the first things that Phil must do is recognize the difference between the skills required for successful planning of a project and the skills required for managing its execution. In the former case, Phil had to be good at staff kind of analysis and at being able to identify technically the stages in the project and estimate times required for their completion. In the acquisition phase, Phil must be much more of a manager and must establish a set of control procedures so that he can monitor progress and take corrective action when it is needed. In this situation, it will require that Phil establish himself with the contractor as a source of support rather than a source of irritation. This can be done by establishing the fact that Phil can help the contractor do his job better and the fact that Phil recognizes his own limitations and is willing to go to others for outside help when it is needed.

Managerial Decision Making

Key Term

Decision

A conclusion reached after some consideration

Human vs. computer decisions

One of the major distinguishing characteristics between human decision-making abilities and computer abilities is the fact that humans can make decisions with pertinent data missing. In some cases, the amount of missing data that can be tolerated and still result in correct decisions is a criterion of the manager's success. This should not be interpreted as an encouragement of decision making without careful thought and analysis; but it does suggest that, when available planning and forecasting techniques have been exhausted without resulting in one clear and obvious path, a manager's intuition becomes a factor. Management decisions, though, should be based on firmer grounds than intuition.

Focusing Quiz

Carefully read each statement that follows. If it refers to a function a computer could serve better than a manager, write C in the appropriate box. If the function could be better served by a manager, write M.

☐ 1. Calculate the completion time of every possible combination of tasks.

☐ 2. On the basis of this information, calculate the minimum completion time.

☐ 3. In the light of this data and less tangible factors, decide on a course of action.

Check your answers in the following text as well as at the bottom of the page.

There are two conflicting factors that can affect the management decision. First, the recent proliferation of planning techniques such as PERT and Gantt charts, with their improvement into PERT-COST and Line-of-Balance, has resulted in an ability to more effectively outline and forecast future dead ends and problem areas. As we have learned in prior chapters, these techniques will also allow the project manager to

Focusing Quiz 1. C 2. C 3. M

gauge the effect of alternative solutions to problems. Unfortunately, every statistically possible alternative cannot be explored, for human beings can only interpret and use a portion of the data given to them, and even then the data must be presented in a form they can understand. For example, let us explore the data digestion process and its application to estimating the manufacturing time required to produce a rather simplified product, such as a shelf bracket used by every homeowner. A computer run of every operation time to make a bracket is useless to the manager. When these run data are changed into numbers, sizes of brackets, and average assembly time per bracket part, he can project the operation time it takes to make a given bracket, based on these digested data. What the manager is doing is projecting a possibility.

Actually, that particular bracket may take more or less time to make, because it is not exactly like any other, and the original basis for projection was an average. However, the fact that the manager had a computer run to use narrows the error range of the decision; the computer run (of all the possibilities) was available to be condensed into an average (or the one best possibility). That is what planning techniques do – they narrow the error range for a specific decision.

The second factor, conflicting with the first in management decisions, is the possibility of greater loss with a wrong decision in a modern project. The manager is no longer faced with a loss in engineering time if a design is not right. Because today project tasks go on concurrently, the manager would then face losses in tooling, production, and material if the engineering design is unsalvageable. By contrast, in sequential design-tooling-production, the cost of a wrong decision would be limited by the point in the product cycle at which it occurred.

Therefore, even though a decision maker has these modern techniques to minimize decision error range for a specific decision, it finally boils down to the fact that if he does make a mistake, it could have a greatly amplified effect.

Step-by-Step Approach to Decision Making

As pointed out before, the continuing charactertistic of the decision-making process, once the project policy and general direction are set, is the persistance of many small day-to-day corrective decisions necessary to prevent the growth of major problems. The manager's prime function is to attend to the constant, small, nudging, back-to-the-rails type of activity. If he can manage the small decisions, the large ones will gradually disappear or might never appear in the first place. A point to consider here is that these small decisions *must* be made. A "no decision" situation is worse than a "wrong decision," because with the wrong decision the manager knows what he did and he can correct it. With no decision, he may not even know how or what to correct when this "no decision" begins to grow – as it inevitably will.

When the manager has a problem, if he takes the time, he can solve it by the classicial procedure: He should ask

1. What is the problem?

2. What are the alternatives?

3. Which alternative is best?

Another alternative is this scientific method:

1. Define the problem.

2. State objectives.

3. Formulate hypothesis.

4. Collect data.

5. Classify, analyze, and interpret against the hypothesis.

6. Draw conclusions, generalize, restate, or develop new hypothesis.

Steps 3 and 6 may be combined if a broad body of raw data is readily available.

Whatever procedure the manager elects to use, he should use it immediately. As Admiral Nimitz is supposed to have said in 1945, "the time for taking all means for a ship's safety is while you are still able to do so."

Many solutions result from perspiration – not inspiration. Conversely, a manager should not devote all his waking hours to the problem. The brain never takes a vacation; it is subconsciously always working. Everyone has had the experience, at some time or other, of being stymied on a particular problem, only to come up "miraculously" with the answer after "forgetting" about it for a while.

Returning to basic scientific principles can assist in making decisions because the manager cannot logically analyze and attack each section of a problem unless he understands it. To understand it, definition is required. He should separate the whole into mentally digestible parts. The use of an established process for analysis, such as the scientific method, should help him to analyze and understand the parts of the problem and how they interrelate. Occasionally, he may find, after analysis, that the real problem is something entirely different from that originally supposed.

Incident

General Consolidated Products: devising a rational approach to a project obstacle

As you examine the following incident, consider what you have just read about step-by-step decision making.

As a member of the finance staff at General Consolidated Products, Rick Wagner had been assigned to head up the firm's upcoming financing project. The firm was anxious to obtain equity financing in the over-the-counter market, and they had assigned Rick the responsibility of coordinating all of the necessary activities to complete a successful stock offering. Rick had been doing considerable outside study on offerings and how they could be handled most successfully. He had also worked closely with the brokerage firm that had been selected to handle GCP's offering. However, he presently faced an internal problem involving the vice president of finance.

For two weeks, Rick had been trying to get the vice president of finance to complete the necessary material for filing with the Securities and Exchange Commission. Rick knew that these items would have to be completed by the following Monday if the project was to remain on schedule. (Previous development and analysis of a PERT network had indicated to Rick that this filing was one of the activities on the critical path for this project.) Since Rick was actually in the Accounting Department, which reported to the controller, who in turn reported to the vice president of finance, he was having some difficulty bringing pressure to bear on the vice president of finance to complete that task. However, Rick knew that he must do something and do it quickly if he was to be successful in meeting the objectives he had been assigned as project manager.

1. What are the alternatives that Rick has? Which would you recommend that he pursue?

2. How should he explain and/or motivate the vice president of finance to complete the required material?

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Organization Environment Analysis

There is a well-known story about the wife who had just learned to drive: she called her husband at work to tell him that their brand-new car was bent to one side. He rushed home to discover that the car had a flat tire and, of course, that one end of the car rode very roughly. When he asked his wife if she had seen the flat tire, she replied, "No, but one wheel was flat on the bottom." The diagnosis of the problem did not agree with the initially reported facts.

An effective presentation requires an effective manner

How the manager presents a proposed solution to a problem may be as important as the solution itself. Some ideas must be *sold* or they may not be adopted wholeheartedly and may therefore be misapplied. This "selling" is not always needed or necessary. The manager is the best judge of when to sell and when not to. Thus, not only during the decision-making process but also subsequently when the solution is presented, the manager should always display a facade of confidence and calm. Nobody supports a loser, but they will back a winner – or perhaps just as important – one who gives the *impression* of being a winner. He may be unsure on the inside, but on the outside, the manager must present a "tower of strength" facade.

In any event, as a manager, make decisions with meticulous care. Investigate, analyze, be objective, but always decide. Decision making

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Incident

One alternative is for Rick to go to his boss, the controller, to see if together they can bring additional pressure to bear on the vice president. Or, he might go to the president of the company, who will undoubtedly be concerned with this project, and get his support. A third alternative would be to go directly to the vice president of finance, explain the fact that the task is on the critical path, and lay out some of the consequences if it is not completed on time. This latter approach is probably the most appropriate as a first step. Clearly, the vice president of finance will not want to delay the project and much of his delay at the present time may simply be a lack of understanding as to its critical nature.

can be learned, and a neophyte's major decision becomes an expert's routine decision. This does not mean that the expert evaluates less; it means that he has already evaluated so many similar situations that the necessary meticulous care has been automatically and successfully applied.

Another advantage of many small decisions is the possibility of learning from small errors. (You will find that you can make success repeat itself; failure is often unique.) To be allowed to learn from small errors does, however, require a favorable management environment, and it is possible to set up this favorable environment. First, instill confidence in top management that you know what you are doing. Second, in lateral relationships with other personnel on your management level, generate a picture of a knowledgeable profit-making mover of people. Finally, help the people who work for you to regard you, from their own specialized view, as an asset. The technical-engineering-scientific people may think of you as a buffer between them and the "irresponsible" demands of staff people. The financial people may think of you as a businessman, and so on.

The main idea is to create your own favorable managing encironment

Analyzing Quiz

The two statements on the left convey a rather negative impression. They suggest a certain lack of confidence on the part of the speaker. In the right-hand column, rewrite both statements in a more positive, confident vein. Be sure to express only the same information.

The Loser	The Winner
"I'm not sure what we're going to do about that."	1.
"All around, this is a pretty good way to do this. I guess it is a little expensive, though."	2.

See response at the bottom of page 12.

Focusing Quiz

Examine the following situations carefully. Then, in each case write in the choice you think the top management of that organization would tend to make.

Situation 1

Organization:	A highly technical aero-space supply corporation
Product:	Gyroscopes
Alternatives:	Either a straightforward financial decision or an engineering decision must be made.

Probable choice: ______________________________

Situation 2

Organization:	A cosmetics manufacturer
Product:	Lipstick
Alternatives:	Whether or not to package the lipstick in a particularly attractive case. Marketing has demonstrated that the new case would be likely to sell an additional million lipsticks. The engineering opinion and the financial opinion are that the additional million lipsticks might not pay off the capital investment.

Check your answers in the following text as well as at the bottom of the page.

Probable choice: ______________________________

The quiz you have just completed focused on a particular point: In some ways, organizations are as distinctive and unique in their operations as people. They have personality and character. Each organization is guided by subtle differences of style and nuances of practice. The upper hierarchy or management level people recognize

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Analyzing Quiz

There are many ways to rewrite these two statements. Two suggestions are: 1. "We've identified the problem, and we're evolving a solution." 2. "We've come up with a better way to do this, and it isn't even going to cost that much more."

Focusing Quiz

The technical firm would be likely to make the engineering decision. The cosmetics firm would probably lean to the marketing decision.

this, because they greatly influence the corporate personality and act accordingly. Sales, engineering, production, quality, or finance may be dominant, and it is wise for the project manager to determine the direction of his parent organization before he starts creating his own project environment.

Each kind of organization tends to have a definite character. Banks and insurance companies seldom have the same personalities that shipbuilding and machinery building firms have. Determine who is on top first and be guided accordingly.

In all probability, as a manager, you have recognized the type of personality that your organization has; otherwise you would not have been given the opportunity to become a manager. A scientifically oriented computer development company normally will not appoint an accountant as head of a digital computer development project. Problems may occur, however, when, as a manager, you have to make a purely business decision that could conflict with engineering requirements. As noted before, it may be the point at which you must freeze a design in order to produce the computer. Unless you have discussed this step thoroughly with upper management and obtained tentative approval, you could have internal problems regardless of the support obtained from sales, finance, or production. The engineering-scientific project group will have many reasons to continue development. These may be improved resolution, higher temperature operation, and so on. You are aware of these facts. However, because you have thoroughly evaluated your organization and obtained the prior approval of the vice president for engineering, your decision to go into production is announced. You, in turn, implement this with the confidence of a manager who is sure of what he is doing. Inside you may not be so sure, because you believe that the engineering-scientific group is not entirely wrong in their desire to continue development. But as a manager, you know that this decision, as well as many others, must be made on the basis of all the data available at the time. The data available now point to an economic rather than an engineering bias, so you start production. In effect, you have changed your "management style" to fit an appropriate phase of your project.

Up-the-Line Cooperation

Instilling in top management confidence in your ability as a project manager can be a result of your prior successful deportment. In general, people are promoted when they appear to be capable. However, there are several rules-of-thumb that can be followed in securing a more positive environment and demostrating capability.

1. Know your own project and also related projects.

Important management functions include planning, organizing, controlling, and communicating. None of these functions is independent of the others, but the communication links that you establish throughout your project and throughout the organization can be considered vital facets of the whole picture. It is not a crime not to have an answer to every problem, but if you do not know that a problem exists when management is already aware of it, you will not be able to generate much confidence. For example, it is occasionally acceptable to say, "The problem is a shortage of blue thingamabobs that is holding up final assembly and we're working on a solution to the shortage," because even though you have not found the solution, you have shown that you are working on it. It is totally unacceptable to say, "Is final assembly being held up?"

Focusing Quiz

What is the difference between the way a project manager keeps informed about a small project and the way he keeps informed about a large one? Draw lines to connect each of the two methods of keeping informed (on the right) with the project size (on the left) to which you feel that method could be more appropriately applied.

1. Small projects
2. Large projects

A. The project manager keeps directly informed about all the specifics of his project.

B. The project manager keeps informed about his project mainly through reports and plans.

C. The project manager has to focus on exceptions to the overall plan.

Focusing Quiz 1. A 2. B and C

The many communication mechanisms discussed earlier should be used to keep the manager informed, but this is a never-ending process and also involves continuous informal dialogues with all sections of the project – just for background data. In smaller projects and in smaller organizations, this requirement is easy to satisfy since the manager is closer to the firing line. His staff is virtually nil and he is as familiar with the latest delivery of vendor parts (which the purchasing agent phoned him about) as with the results of the latest engineering test (since he probably helped to run it).

With a larger project, intimate knowledge of all aspects becomes difficult because of the great mass of data available. Communications then become a digestion process and reports and plans become more important. These reports should be designed around the "exception" principle. If the project has been fairly well documented insofar as planning is concerned, the main concern of the manager is to be aware when an exception to the plan occurs. He should arrange his communications links so that information about a test failure, a rejected group of parts, or a missed delivery date will be forwarded to him immediately. Of secondary importance is the information that a test was satisfactory. This does not mean that he should discourage inputs regarding plan achievements; rather, he should attempt to set up input priorities, with the higher priority for exceptions rather than achievements.

As part of a self-education process, a manager should periodically make himself an "expert" in some area with which he has been only superficially familiar. For example, he might pursue a study in quality control procedures. The project manager selects several expensive vendor items and asks the following questions to determine the scope of the incoming test procedure:

Is it adequate?

Is it too elaborate?

What procedure has been followed in rejecting products?

Has the vendor taken appropriate corrective action?

Is the vendor's test system adequate?

When he has finished the study, he may either discover that nothing is wrong, or that a major catastrophe is slowly building in the stockroom due to potential failures of that particular product occurring in the near future.

The major point of "knowing your own and related projects" is that in order to know most aspects of your project, a constant random investigative technique can be used in addition to organizing an adequate, formal, internal reporting system, as shown in Chapter 3.

Even though the manager's knowledge of other organization and related programs can be superficial (because there are only a limited number of hours in a day), he should never become "tunnel minded" to the extent that nothing exists but his project. This attitude may be a good political ploy when competing with other managers for a share of a limited organization resource. However, in some cases, if the other fellow's project is more important to the organization, it is always good to know this so that the manager can adjust his project if necessary.

Focusing Quiz

The following checklist for up-the-line cooperation contains both good and bad advice for the project manager. Cross out the bad advice.

✓ 1. Deal with top management indirectly.

✓ 2. Send reports only to management level directly above you.

✓ 3. "Butter up" reports to top management.

✓ 4. State problems clearly in all reports.

✓ 5. Write it, don't say it.

✓ 6. Avoid forecasting a date by which a problem will be solved.

A second rule for attaining up-the-line cooperation

2. Pass all pertinent information along to people in higher management. Do not delete data on project difficulties.

If top management had not directly backed the systems-project concept, it would not have been implemented. During the project organization phase, one of the first and most important steps was a top management direction that project management was organization policy. Occasionally, the top hierarchy may include an incompetent individual who has become an obstacle to project progress. He may have been retained because of nepotism or because of the reluctance of

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Focusing Quiz

You should have crossed out items 1, 2, 3, and 6. The text explains why.

the powers-that-be to admit that they have an incompetent. As a general rule, however, it is wise to assume that a profitable organization is the result of efficient management, and its people are well qualified for their positions. They probably have been through every vicissitude that you, as a manager, will go through, and if informed promptly about an incompetent individual, they will not be unsympathetic. This last evaluation is, of course, subjective, and you must judge for yourself (as in all of these suggestions) how and to whom you apply the rule.

> It does not pay to be indirect in your dealings with upper-level management. Generally you can speak or communicate more directly up than you can down; first of all there are less people to communicate with up than down, and secondly they generally have a broad knowledge of the managing process. This relieves you of a lot of the "background explanation" needed for communication downward in the organization.

Do not embroider reports in order to obtain a favorable review of your project.

The idea of "buttering up" a report to management so that it will hear only good news and consequently think of a project in favorable terms falls flat when the first major problem that cannot be covered up appears. Instead of assuming that a manager has been hard at work on a solution for weeks and something unforeseen has occurred, top management will suddenly be confronted with a major problem and assume that they had not been properly informed in the past. In the long run, accurate reports help a project to become known as the one that is coming along, solving its problems as it goes, instead of the project that had that "terrible disaster." Nevertheless, if the manager communicates with no evasions, there is no reason that he should not also communicate project successes.

The manager should attempt to provide report copies to several upper levels. This does not suggest bypassing management levels on a normal basis. It does suggest that the manager ensure that at least two and possibly three levels above are aware of project progress so that management oversight will not prevent a broad dissemination of these reports. It could be an error to communicate with only one man; he can become sick, transfer, or even leave the company. This could precipitate a learning crisis with the next upper level of management.

As a project manager, attempt to maintain a report format that can be easily followed. The following format is suggested:

1. Statement of the problem

2. Recommended problem solution and/or actions being taken

3. Impact on cost/schedules/performance

4. Forecasted get-well date

5. Reason for the problem

Anyone who receives the report can then work from the answers you suggest through all the reasoning processes that you have already completed, if he so desires. When enough successful solutions occur, it is doubtful that much reading will progress beyond Step 3.

You will find that as you build up management confidence in your decisions, there will be very few questions asked, so do not equivocate when questions are asked in the project's beginning phase. And remember to adhere to the following two rules in all your up-the-line communications:

- Document it with less words but definitely document it. Be simple, be short, be positive, be brave, be specific. Think thin! If they want more data, they will ask you for it.

- Don't say it, write it! If you cannot write it, either it is not very important or you do not understand it – so forget it. In some cases, the more words you use, the more confusing it can become.

Reviewing Quiz

The following statement comes from a report about the use of a certain fluid for cleaning plumbing systems. Read it carefully, and then, in the space provided, rewrite it as clearly and briefly as possible.

> The continued use of this material in the state of concentration used appears to be a major causative factor in the apparent progressive destructive conditions of the fluid conduits.

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Reviewing Quiz

This fluid destroys pipes.

> Take time to condense.
> Rewrite, if you must, for brevity and clarity.

Incident

Midwest Airlines: formulating an effective memo

As you examine the following incident, consider what you have just read about written reports.

Steve Berman had been assigned by the president of Midwest Airlines to supervise the company's attempt to obtain approval for offering shuttle service between Pittsburgh and Cincinnati. As project director for this, Steve had recently encountered a problem with the operations scheduling group at Midwest. Steve had prepared two memos *reporting this problem to the president* and was wondering which of those he should actually send.

Memo A

> I am not sure exactly where the problem lies but we seem to have reached an impasse in pinning down what kind of schedule will be feasible and what we can best support in connection with our new shuttle proposal between Cincinnati and Pittsburgh. I have been after the operating group to give us specific information as to how many planes would be available and how frequently we might be able to fly that route. Of course, they also need to provide crew support and that seems to be an additional problem. I've been trying to work closely with them, but don't seem to be getting very far. My thoughts are that they are just dragging their feet and aren't giving it very high priority on their things-to-do list. Any help you can give on the matter would be appreciated.

Memo B

> I have recently run into a problem in connection with the Pittsburgh-Cincinnati shuttle project and would like to get your support on the matter. The problem is that the operations people are not allocating sufficient resources to complete a proposal for equipment and crew scheduling for that shuttle service. Since this activity must be completed by the end of next week if we are to remain on schedule on this project, I estimate that they need an additional two people assigned to it for the next several days. I would appreciate it if you could contact the head of operations and get his agreement to that. I have tried to do so but so far have been unsuccessful. I estimate that if we have that kind of support that we can remain on schedule and the cost, if fact, will not be any higher than we had originally estimated. I will check back with you tomorrow as to what information you obtain.

What is missing in each of these memos? Which would you recommend that Steve use? Why?

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See response at the bottom of page 20.

Focusing Quiz

Circle each statement that offers sound advice for establishing up-the-line cooperation.

1. Make use of your top-management contacts as often as possible.

2. Always rely on your own knowledge. Consult others only after a crisis occurs.

3. Get to know as many top management people as you can.

3. Know your contacts.

A third rule for attaining up-the-line cooperation

The advisability of knowing people in upper management levels is fairly obvious. Although it is also fairly obvious that as a project manager, you cannot presume on this knowledge except in very rare occasions. But like life insurance, it is nice to have in case of extreme emergency.

Learn how to use human resources when faced with a problem

There is another aspect to knowing people, not necessarily in high places, that we will review here. An executive accomplishes his tasks through people. The more people he knows, the greater the pool of knowledge which will contribute to achievement of organizational and personal goals. Although there is no attempt here to downgrade personal knowledge and accomplishment, in many cases the knowledge of whom to call to solve a specific problem can be as important as a personal solution. No man can be an expert in everything. Some man, somewhere, is an expert in the solution of the immediate problem, and often it is cheaper and easier to find him than to do it yourself. This applies not only within the organization but outside it as well. For example, assume that your project is operating at a given labor rate and overhead factor. One day you learn that the organization has landed a large contract which, although unrelated to your project, will use some of the same facilities that you are using. A quick call to the controller of the division that got the contract and you have a projection of how

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Incident

Clearly, memo B is the better of the two. The first memo lacks a clear definition of the problem and does not suggest a solution. In addition, it does not specify the level of importance of the problem, the time frame in which it must be solved, and the follow up procedure for the project manager. All of these are overcome in the second memo.

Focusing Quiz

You should have circled item 3 only. As the text that follows suggests, you should use your contacts with discretion. You should not, however, wait until your project is about to collapse.

your project overhead rates will be affected by this use of common facilities. It may be that your rates will decrease, allowing you to divert some planned overhead funds to a production problem that had just cropped up. Without knowing the controller on a personal basis, your ability to get this information could have been severely limited.

Your Dry-Run Project

Consult the organization chart you made in Chapter 2. In the space below, list all the top management personnel you might need to consult in the course of your dry-run project. Circle the names of those you could approach on a personal basis. You might wish to become acquainted – or better acquainted – with the others.

Focusing Quiz

Below are four rules of thumb for dealing with subordinates. Find the one false rule and cross it out.

1. Toughness is never a substitute for agreeableness.

2. Dissension can be the result of managing correctly.

3. Many personal frictions can be minimized by well-ordered management.

4. People are often more disturbed by not knowing what to expect than by being sure of what will happen.

4. Be aggressive – but never lose your sense of values or humor.

The first part of this rule is something with which you probably are quite familiar; otherwise you would not be a manager. The Casper Milquetoasts of the world do not rise very well in the average industrial situation. This does not imply that a driving, overbearing individual is the one who will always succeed. It does imply, however, that a self-starting, continuously progressing individual is more likely to achieve organizational and personal goals.

The effective executive rarely lets other goals obscure his own.

It is not necessary nor should it be assumed that an effective executive has to be well liked. We are not examining the organization extremes of the cutthroat, step-on-the-other-guy, or the everybody-wears-the-same-school-tie, let's-not-rock-the-boat type of organization. We are concerned with an organization of diverse personalities in which some people will rise, some will fall, and some will just coast along. Dissension can also be caused merely by managing correctly. For example, somebody's feelings might be hurt if you divert funds from one project area to another when you find this necessary. It is bound to happen.

People are often more disturbed by not knowing what to expect than by predictable working conditions.

If the manager can establish a well-ordered management pattern, many project-personal frictions can be obviated, since the people concerned can foretell what his reactions might be in most situations. For example, if the manager's policy is to have everyone at their desks promptly at 8:15 every morning, and he discharges an employee for chronic lateness, it may not please the affected employee's friends, but they will have expected it, and therefore consequent frictions are reduced. Affection in a working situation can be subordinated to confidence that the manager has a relatively predictable frame of mind.

Focusing Quiz — You should have crossed out item 1. The text explains why.

The manager should set a high standard of activity for both himself and his project personnel within a well defined personnel policy.

There will be times, however, when being aggressive and being right just are not enough, and the manager will lose the battle. A battle is not the whole campaign. The manager should document his position thoroughly so that in the future the exact situation will not become dimmed in his memory; he should then file the document and go on. That document file may be valuable for reference at a later date.

5. Distinguish between the important and unimportant.

This suggestion, of course, is analogous to the politician who is "against sin and for the American way of life." Everybody wants to distinguish between important and unimportant, between good and evil, between sin and morality. But in the management context, except for straight ethical decisions covered in Chapter 6, all data and every decision must be evaluated in terms of their effect on the manager and his project.

Incident

Consider this point as you read the following incident.

It seemed to Gabe that everything had to go wrong at once, especially on a project where time was as critical a factor as it was on this one. That morning a fire broke out in the stationery department and thousands of dollars worth of notebooks, typewriters, and supplies were destroyed. On his way back from inspecting the damage, a foreman brought him more bad news: two inexpensive but essential drill jigs were ruined. There were no replacements on hand, and the toolmaker had been assigned to another project. For the moment, he put the stationery problem aside. He would have to see about replacing the drill jigs first.

Was Gabe right in seeing about the drill jigs first? Why?

See response at the bottom of page 24.

The difficult differentiation between important and unimportant occurs when the future projection of the data being evaluated is unsure. Is it important to report that a vendor is late in his deliveries of a critical item when you have already authorized overtime to account for this? A standard to use in these cases is – do not spring surprises.

No one likes surprises that make him feel that he has been uninformed. Therefore, even if a problem has been potentially resolved, if it can become unglued, this problem is important and should be reported.

6. Adjust your briefings to the audience.

The information that the manager passes on to quality control will not necessarily be the same information passed on to sales. Another example of specialized information is the type passed on to the customer. This does not mean that the manager should hide data, but he should remember the interests of the group or individual with whom he is communicating. In some cases, he may even have to adjust the content level of data supplied.

Incident

Consider this point as you read the following incident.

The project manager scanned the production report In the preceding month there had been three rejections. That was 2 per cent of the total – just the acceptable number. Actually, it was preferable to have those three rejections. With zero rejections there was always a reasonable possibility that the lot would contain 2 per cent rejectable material when it was shipped out.

Satisfied with the data, the manager began to make his reports to quality-control management and to the customer.

1. If you were the project manager, how much of the above production information would you include in your report to management? Why?

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Incident

Gabe was right. Time was short, and even though the stationery had a higher dollar value, it could be replaced quickly. The drill jigs would be harder to replace, and without them, production would be delayed.

2. How much of the information would you include in your report to the customer? Why?

Along-the-Line Cooperation

There is a well-known recipe for cooking wild duck that starts off: "First, catch a duck." Similarly, in order to generate a favorable environment among his peers, the project manager must first determine what hierarchal level he is on and then who his peers are. This could be important if he attempts to operate either higher or lower in the organization than his project's importance would justify. At this point, we can assume that the project manager has the required technical, educational, and personal attributes that enable similar-level managers to recognize that he knows his job and will succeed at it. It is immaterial whether he has been promoted from within or been recruited from outside the organization. It is up to him to ensure horizontal freedom of action by assuming, maintaining, and demonstrating project authority. If the project is a major one, other managers in the organization will recognize him as a peer when he has line authority.

Some organizations have people called project managers, but these people have only staff authority, even though they are given line responsibilities. Other organizations have "real" project managers – project managers who have line authority. Because the nature of their authority differs, each of these two kinds of project manager has to go about his job in a somewhat different way than the other.

Incident

1. You would just tell management that there had been three rejections out of so many items. You can assume they will know that on the average 2 per cent of the items will be defective and should be caught.

2. You could not assume the customer knew anything. You would tell him both about the number rejected and the average expected rejections.

Focusing Quiz

The distinction between line and staff authority

Draw lines to connect each statement about the way a project manager can operate (on the left) with the statement about the extent of his authority (on the right).

1. The project manager must constantly refer back to his principal line supervisor for authority.

2. The project manager can act without referral to his principal line supervisor.

3. The project manager should use skill and persuasiveness in his operations.

4. In a crisis, the project manager can more easily redirect funds and personnel in order to implement his solution.

A. The project manager has only staff authority.

B. The project manager has line authority.

A project manager who is not given line authority is not given all the autonomy he could use. Consequently, he must pursue performance objectives with a great deal of skill and persuasiveness and must constantly refer back to his principal line supervisor for authority. He is not on a level with line managers. This situation is not inherently incorrect, provided all concerned are aware of the project manager's lack of authority and are occasionally willing to allow delay and lack of achievement in pursuing project goals. The "real" manager (defined here as one who has line authority and can act on his own without either immediate referral to his principal or recommendation to his functional managers) should also use skill and persuasiveness in his operations. But when an emergency arises or speed in implementation of instruction is required, the "real" manager has a much better chance of success because he can redirect personnel and funds away from other goals with a minimum of consultation. If he is responsible and has control – he can do it. With no control, the project manager must take time to consult with the supervisory authority level or else attempt to

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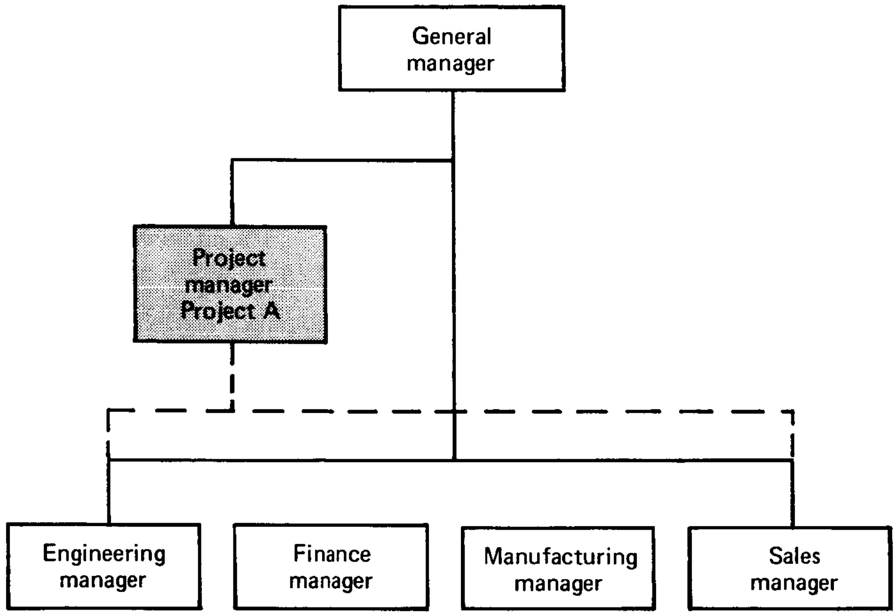
Focusing Quiz 1. A 2. B 3. A and B 4. B

These answers are explained in the text that follows.

persuade affected personnel to follow his direction. A sample organization showing staff managers is shown in the following diagram.

Sometimes a dotted line (as shown to project A) connects the project manager and his project. This is intended to show communication links while the solid lines shows authority-responsibility links. Generally, dotted-line relationships are tenuous and eventually become a function of the individuals' personalities and needs.

Staff project managers



The quote is from The Theory and Management of Systems, *Johnson, Kast, and Rosenzweig, McGraw-Hill, New York, 1963.*

"One of the greatest defects of line and staff management is that it is difficult to place accountability in any one person; conversely one of the greatest assets of true horizontal (or line responsibility) project organization is the ease with which accountability is placed." However, in the interest of project progress and goal achievement, it is necessary to attain direct line control over only two aspects of the project. If the manager can control the salaries and tenure of the personnel on the project, half the battle is won. If he can control the expenditure of other project funds, the other half is won. All other controls stem from these two, and with this, accountability to the project can be maintained.

The manager, therefore, can ensure that the project is truly an autonomous operating unit by attaining these two controls. Other managers and project personnel will then recognize it as such.

The assignment of functional personnel to a project provides some very definite opportunities for personal growth, which may not be emphasized by other managers. "Along-the-line" cooperation from other managers is definitely achieved when these managers agree that the opportunities are real.

Reviewing Quiz

What kinds of direct line control must a project manager have if he is to effectively run his project?

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Down-the-Line Cooperation

Reviewing Quiz

Earlier, we discussed, in a general fashion, the overlapping roles of project and functional managers. Use the following quiz to check your knowledge of the responsibilities of each kind of manager. If the responsibility described in each statement properly belongs to the functional manager, write F in the appropriate box. If it belongs to the functional manager, write a P.

☐ 1. The responsibility to deliver something on time

☐ 2. The responsibility to deliver something to specification

☐ 3. The responsibility to deliver something within budget

☐ 4. The responsibility for the day-to-day administration of personnel

Incident

As you examine the following incident, consider these kinds of distinctions between the responsibilities of a project manager and those of a functional manager.

It took Ron a long time, but at last he found the design engineer he wanted – or at least he thought he did. There was no doubt that his man knew how to lay out and design a specific item in accordance with Ron's directions. The problem seemed to be to get him to do it.

It was bad enough that the man came late to work – first five minutes, then ten, and now it was close to half an hour. It was worse that once the man did get to work his output was marginal. But the man's surly attitude made his presence unbearable. Ron would have to do something about this.

Reviewing Quiz — The project manager has to control the salaries and tenure on the project of the personnel. He also has to control the expenditure of the project funds.

Reviewing Quiz — 1. P   2. P   3. P   4. F

As project manager, what would be the appropriate action for Ron to take at this time?

Two-headed management

As we have stated before, project management creates finite and concrete responsibilities for performance. One area outside of the project manager's control is that of personnel administration. There is good reason for this.

> It may be that an individual's services can be used only on a part-time basis. For example, with a small project, a financial controller would not be needed full time. Changes in personnel needs during the project life may require that some originally required skills be returned to the corporate "pool" of people and others drawn out. This personnel administration problem is therefore handled by removing it entirely from the project.

On the surface, this management philosophy conflicts with the "one man reports to one boss" classical management theory. In practice, it is no different from other life situations. For example, the student at a university has certain responsibilities to each instructor (project manager) for each particular course of study, but he has different relationships and responsibilities to his parents (spiritual leader).

The disadvantage of this system is that project personnel may retain certain attitudes and loyalties to their spiritual leaders and rarely become as dedicated to the project as they might if they had been hired solely for the project position. In the final analysis, however, everyone is aware that the project has a finite ending and perhaps it is better that the project people feel that they can always go back to their

Incident

The project manager should go to the design engineer's functional supervisor (probably the chief engineer), who must then do whatever is necessary either to get the man to perform as the project manager wishes or to replace him with someone who will.

engineering, financial, or other department if the project is completed before a succeeding project can absorb them. As long as the manager can maintain a rapport with the respective spiritual leaders, there should be no problems of major import with project personnel that cannot be cooperatively solved. Getting cooperation from project personnel is a straightforward matter of achieving authority and recognizing human limitations.

Reviewing Quiz

Circle each item that makes a valid statement about project management.

1. Because a project is of limited duration, some personnel may only make a limited commitment to it.

2. Project management has the advantage of having clearly outlined goals for performance, time, and budget.

3. Project management personnel need only be employed on a project as long as they are serving some definite purpose.

In earlier chapters, we discussed various planning mechanisms and how to allocate resources, both human and financial, to meet a plan. It is difficult to require a person to change work systems and interpersonal relationships to meet a plan. He may feel that the requirement to change threatens his job status or economic security. Certainly if he believes that his status or income could be lessened because of this change, he will not be impressed with anyone attempting to convince him that it's good for the organization or for the project. Uncertainty, which is bred by lack of communication, may result in reluctance to support a project. Disruption of superior-subordinate relationships caused by his getting a new fearless leader (you) may require a short training period. The project assets of definite goals and plans should be used to minimize his uncertainties in changing from functional status to program status.

Your Dry-Run Project

Have you thought about the potential sources of uncertainty that might cause resistance among the people you selected for your Dry-Run Project? Think about your personnel as you read the following list. Check the box before each item that suggest an area where you will have to overcome employee uncertainty in order to establish your authority.

☐ Threat to job status

☐ Threat to economic security

Reviewing Quiz — You should have circled all three statements

- [ ] Threat to comfortable, established ways of doing things
- [ ] Threat to interpersonal relationships
- [ ] Threat to accepted and established lines of authority

This quote on authority achievement comes from Principles of Organization and Management, *Albers, 2nd ed., Wiley, New York, 1965.*

"The established patterns of authority must have general acceptance if they are to survive. Too much use of force is disruptive and indicates a breakdown of existing patterns." This quotation illustrates the problems you face in achieving authority. Remember that your appointment as a project manager does not achieve any real authority for you. It merely grants you the right to attempt to achieve authority.

The parent organization is an "established pattern of authority," set up on a functional basis in which most of the personnel know and accept the management philosophy and hierarchy. By upper management direction, the entirely new project is created horizontally across traditionally functional lines and disrupts normal procedures. In effect, it has been created by fiat.

The project manager can use this fact to his advantage. Even though much of his management activity is spent in projecting new plans and eliminating the disruption of established plans and a great measure of his efficiency is the ease with which his plans are followed, there will be an initial normal settling down period and it is in this period that he could be required to act. In an extreme situation, as characterized by an initial lack of positive personnel response, there is the alternative of recommending an individual's transfer or discharge by his spiritual leader. Possibly the individual concerned has been uncooperative in the past and his spiritual leader would be prompt in following that recommendation. If in the manager's opinion, this extreme is not required, then a secondary course of action should be followed. A "talking to" with the particular individual, in company with the man's spiritual leader, may be all that is required. The manager will generally be supported by the spiritual leader, because he certainly *should* have been aware of the man's behavior.

Your Dry-Run Project

Check the box before each approach to establishing authority that you feel conforms to your personal style, to the style of your organization, and to the needs of your hypothetical employees.

Evaluate these suggested techniques in terms of how effective they might be on your prospective employees.

- [ ] Attempt to play down the fact that all personnel must have your approval in order to receive salary increases. There is no need to carry an obvious club. Carrots work better during project operations. You also have the option of recommending increases for people, and because your project is paying them, a recommendation from you carries quite a bit of weight.

Some techniques used in the achievement of down the line cooperation will not necessarily coincide with techniques to which you would respond.

☐ Attempt to build personal loyalty by protecting project personnel from extra-project requirements. Technical people, specifically, often feel that administrative requirements such as reports, time sheets, estimates-to-complete are superfluous to the main task of "getting the job done." In some cases, you may agree with them. When you do, you may either pass the task on to an administrator, attempt to obviate the task, or in the last analysis explain the need for the report to the scientist-engineer-technician who must supply it. If you protect your people, they will protect you. In any event, protecting them from extra-project demands will let them get the job done faster for you. Gratitude can be an unexpected dividend.

☐ As another point, it is inadvisable to ignore minor intentional deviations of project personnel with respect to their duties. Like small problems, they do not just go away if you do nothing – they always get bigger. If these deviations become a problem situation, it might be practical to select a relatively minor bone of contention in which you are absolutely certain of your ground. Then, as objectively as you can, thoroughly point out to the concerned individual where his problem areas are and request that he supply a plan for correcting the situation. The implications of this request can be interesting.

☐ Have the project organization chart distributed. When an individual identifies himself as part of a successfully going project, he becomes more willing to adhere to project plans and procedures.

☐ Employ status symbols as rewards. If it is socially important to have a parking spot next to the main plant, you might attempt to gain a block of these spots assigned only to your project. Other things such as special badges or identification can be quite useful.

Military services make wide use of this last technique. They need to, because they operate organizations in which personnel changes can be very rapid – especially in wartime. They have therefore developed the use of authority symbols, such as insignia, and indoctrinated the troops in the idea of saluting the rank, not the man. The transfer of authority is consequently greatly simplified. A new colonel transferred into a regiment is immediately recognized by the insignia he wears. The use of battle ribbons and campaign medals generates respect. A soldier can then know by inspection that the new man is a colonel who has fought in several battles, received wounds, and so forth, and in all probability decide on the spot that the wearer of the insignia is worthy of his authority.

In industries such as defense, where internal security is required, the use of special badges for projects can be encouraged. Ostensibly, this may be justified for other reasons, but practically it can instill a sense of program unity.

> None of these techniques for attaining authority can be repeated forever. The specific technique and the frequency of its use must be carefully chosen. A manager should find less need for direction and more for persuasion as time goes on.

Remember, for every tactic the manager may employ, lower level personnel have an answer if they wish to use it. The answer may vary from the extreme "I quit" to a subtle "misunderstanding" of instructions. An excess of jobs over job-seekers may cause employee independence while a reverse situation may cause employee acceptance of otherwise "intolerable" conditions. Neither of these extremes is acceptable for effective operations.

Meetings and Their Uses

Meetings are held for three reasons: problem definition, information dissemination, and future planning. Each category can be subdivided. The important aspects of a meeting are the reason for calling the meeting, the pre-meeting preparations, the meeting administration, and the postmeeting followup.

Key Terms

Problem-defining meetings
Meetings held to explore all known facets of a particular issue.

Information-disseminating meetings
Meetings held to communicate specific data to a number of people at the same time.

Planning meetings
Meetings held to gather ideas and to form a consensus regarding an over-all goal; concrete planning is later based on the inputs of these meetings.

One indirect advantage of meetings is the attainment of authority. When the project manager calls a meeting, controls it, and documents it, everyone concerned receives the impression that he is directing the actions of others and that he has the authority to do so. This is not a major reason for a meeting, but if it serves the purpose, why not capitalize on it?

Focusing Quiz

Read the following example of a meeting, and answer the questions in the space provided.

The machine shop of the XYZ company has a tremendously high rejection level on piston actuators due to apparent pitting of the metal bore. After exploring it thoroughly in a meeting with production, engineering, quality, and procurement, the project manager draws a tentative conclusion: the facts may show that the original raw material was not purchased to the blueprint. The problem has now been sufficiently defined to turn it over to engineering for solution. They are to be asked: Is the purchased material usable? Can the pitting be corrected? Can internal program controls be instituted to preclude a recurrence?

Which of the three kinds of meetings is this? Why?

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Your Dry-Run Project

There are a number of ground rules for successful meetings. Check those that you feel might work in your Dry-Run Project.

☐ **Be sure you pick the right people to attend.**

In some cases only a group representative is needed, such as the comptroller for a project general review meeting. On the other hand, not only the comptroller but the contracts manager, the estimator, and

Focusing Quiz

This is a problem-defining meeting: The project manager had a specific problem in mind when he called it. The focus of the meeting was to discuss the various aspects of the problem. And the meeting was dissolved when some section was assigned to come up with a solution.

the financial control manager may be needed if the meeting is on estimate-to-complete. Invite only those people who are directly concerned. If an individual is not wholly needed, let his meeting representative tell him about it later.

☐ **Issue an agenda or inform attendees of the subject to be discussed.**

Possibly you can suggest particular areas to be investigated by specific participants prior to the meetings.

☐ **Depending on the nature of the meeting, resist the temptation to dominate all the time.**

While it is true that you will probably be the chairman of most project meetings, this does not mean that you are required to supervise every bit of data transmitted. Informality should be encouraged in order to maximize all the attendees' inputs. Occasionally, let the meeting run along, but always take hold when it appears that nothing more will be gained or time is about up.

☐ **At planning meetings, attempt to ensure that the most junior of those attending is called on for suggestions first.**

☐ **Assign one man to follow up a decision when he has the facts or a direction.**

Committee solutions to daily and immediate problems are incomplete because when a committee solution is proposed, the next step is implementation. Committees are notoriously poor at doing things. Individuals on a project level can do things. Generally, the larger and the longer the problem, the better the committee consensus becomes.

☐ **Sum up verbally what the meeting has done and then document it.**

Take minutes, assign tasks, but always take hold at the end and be sure something is accomplished. If you thought it was important enough to call a meeting, you must have known what the objective would be, and either the meeting will produce that objective or it will produce another one equally acceptable to you.

☐ **Issue minutes to those attending and other interested parties.**

Show accomplishments and directions and be sure to specify dates by which time certain tasks should be completed.

Incident

The Smith Pharmaceutical Company: acquiring a consensus for a problem solving technique

As you examine the following incident, consider what you have just read about cooperation.

The Smith Pharmaceutical Company had recently encountered problems in the quality control area. Having been forced to recall all of the units of one of its major products, the company had responded by reassessing its quality control efforts. To head up this project of reassessment and implementation of improved methods, Carter Cornwall had been appointed as project manager. Carter's background was in construction engineering and thus he had a good working knowledge of the selection processes involved and where quality control might be appropriate.

As a first step in conducting this project, Carter had met with the marketing people and with the engineering people and determined what levels of quality were desirable and how they might be best measured. He then met with production engineering and determined what activities needed to be performed in order to accomplish implementation of the desired quality control program.

Carter had done some reading about quality control programs in other companies and was aware that they frequently did not work as planned. Often, they took considerably longer to implement than their designers originally estimated and frequently the cost in terms of lost production time and in terms of rejected units was very high. Carter was anxious to avoid these kinds of problems at Smith Pharmaceutical and thus wanted to be sure that he had considered all important factors. He saw five areas in which major activities would have to be undertaken for successful implementation.

1. Determining the cost of his quality control program and refining it to match market and production activities
2. Verifying quality-checking procedures
3. Training production management personnel as to quality requirements
4. Training production workers
5. Establishing ongoing procedures for monitoring consistent application of quality control

1. How would you recommend that Carter should initiate the implementation phase?

2. What kinds of meetings should he hold? What agenda items should be covered in those meetings? What kind of criteria should he use for evaluating his success at implementation?

Incident

Up to this point in time, it would appear that Carter has successfully planned this project and is the right person for that first part of the task. However, in the second part of the task, his challenge will be somewhat different in that he must now gain commitment from Production to support the project and to make it work effectively. Undoubtedly, problems will arise that no one could have foreseen and Carter's success at solving these, with the help of Production, will determine the ultimate success of the project.

One of the things that Carter should avoid is referring to this project as his quality control project. He clearly needs to gain the level of commitment necessary so that it will be viewed as the corporate quality control project rather than any individual's project. He should perhaps start by sitting down with the head of Production and gaining top-level commitment for this program. That management person could then direct him to others in the Production group who could be given sufficient time to work with Carter in implementing the program. The criteria he should use for evaluating success should be meeting those time and cost commitments associated with the project that Production management is willing to agree to. He should not set up a set of objectives or performance measures that are different than those Production would establish. The closer his objectives match those of the rest of the organization, the more likely it is that he will achieve success.

Translating Technical Language Into Plain English

A good manager understands every aspect of his project in the general sense, whereas a good engineer (for example) understands every aspect in the specialized technical areas. An engineer, however, because he is concerned mainly with technical problems, can take the time to become familiar with and master the activities of the specialists. If the engineer does not understand a test procedure, he will review the test mechanisms and how they cause the system to act until he is satisfied with the procedure. He therefore becomes thoroughly familiar with the work of the test engineers.

You as a manager have a similar problem; however, it is greatly magnified over that of the engineer. You must understand not only the specialists in engineering, but also the accountants in financial control, the machinists in manufacturing, the lawyers in contracts management, and many others.

Focusing Quiz

How would you, as project manager, respond to a section manager who was explaining a problem in language too technical for you to understand? Of the three responses suggested below, circle the one that would be most likely to leave you in control of the situation.

1. Trust in the judgment of your specialist.

2. Press your specialist until he explains the matter in language you understand – even if he becomes annoyed in the process.

3. Fake an understanding of the issue, and thereby maintain your authority in the eyes of the specialist.

The project manager develops a working knowledge of each specialized area but there will come a time, for example, when an accountant tells him that "the marginal utility of the extra investment is not going to be over 50 per cent," or an engineer tells him that "the frequency response at 90 cps. is less than 40°" If he does not know what this means, he cannot evaluate its importance. If he cannot evaluate its importance, he may have a major fiasco, and no one likes fiascos. The manager must find out what the accountant or the engineer is saying – in common-sense English. There is a simple solution. He can

Focusing Quiz — You should have circled item 2. The text explores this matter further.

ask questions – and not let go until the answers coming back are understandable.

> "What do you mean – marginal utility?"
> "Oh, you know – in an economics sense."
> "No, I don't know – marginal utility?"
> "Well, it has to do with investments."
> "Yes, go on."

If the manager is persistent, quiet, bland in his questions, he can translate anything. He may not be able to take the time to understand the fine mathematics of a highly complex feedback control system, but he certainly should be able to stick with the project engineer until he can, in general terms, explain how it functions.

A manager may find that the specialist under questioning becomes annoyed. He should keep in mind that *not* knowing is inexcusable and press on – quietly and blandly. Occasionally, if the individual is not prepared to answer, it could take several sessions for the manager to understand the problem.

Summary of Chapter 5

Once operations have begun, the project manager's job changes considerably. Setting up a project is a relatively straightforward, logical procedure. In contrast to this, the day-to-day solution of unforeseen problems requires exceptional management skills. Now the project manager must combine the scientific tools he used in planning with the highly individualistic style that he develops to make sound decisions with incomplete data. He must demonstrate skill at the plain politics of working with people. In addition, he must change his management style from supportive to directive. This is a very difficult thing to do since most of us have only one personality.

From this point on, most of the decisions the project manager will have to deal with will be small day-to-day corrective decisions necessary to prevent the growth of major problems. Among the best approaches to solving such problems is the following classical procedure. Ask:

1. What is the problem?

2. What are the alternatives?

3. Which alternative is best?

As useful as such an approach can be to a project manager, it will not be enough in itself. He will also have to be a master of methods of obtaining confidence and a favorable environment for his decisions — methods that vary from one management hierarchy to another. If, for example, the project manager has been given only a staff position, he will have to operate more indirectly than if he has been given both staff and line authority.

Whatever the nature of the parent organization, the project manager will find meetings to be useful tools for planning, disseminating information, and defining problems. They will also provide a platform from which the project manager will be able to demonstrate his authority.

Chapter 5 Progress Check

Indicate true (T) or false (F).

1. In the acquisition phase of project management, a project manager's manner in dealing with people is different from what it is in the conception and definition phases. ____
2. One of the major characteristics distinguishing a management decision made by a person and one made by a computer is that the human can make a decision with pertinent data missing. ____
3. The project manager will always have to sell his ideas. ____
4. Different kinds of organizations tend to have different kinds of management orientation. ____
5. In establishing his authority, the project manager should follow set rules; the management orientation of his particular organization is a relatively unimportant consideration. ____
6. Memos and briefings should be adjusted to the audience for whom they are intended. ____
7. To manage effectively, a project manager needs direct line control only of project funds and top management support. ____
8. Committees are good at reaching solutions; individuals are good at implementing solutions. ____

Circle the letter before the correct answer.

9. A project manager can avoid

   a. making decisions concerning minor adjustments in his project

   b. making major decisions

   c. both of the above

   d. neither of the above

10. In dealing with top management, a project manager should attempt to

   a. appear confident

   b. conceal or minimize problems

   c. both of the above

   d. neither of the above

11. A project manager should

    a. avoid making decisions unless he has all the information

    b. be as meticulous as possible in making decisions.

    c. both of the above

    d. neither of the above

12. In order to perform his job capably, a project manager should

    a. know as much as possible about his own project

    b. know something about related projects in his own organization

    c. both of the above

    d. neither of the above

13. The larger the project, the more necessary it will be for the project manager to

    a. manage by exception

    b. keep informed about his project through reports

    c. both of the above

    d. neither of the above

14. Written reports should

    a. be as complete as possible

    b. make use of all possible technical terms

    c. both of the above

    d. neither of the above

15. To be an effective executive you should

    a. do everything possible to be well liked

    b. be consistent and fair in the way you treat your subordinates

c. both of the above

d. neither of the above

16. A project manager with only staff authority

 a. can act without referral to the principal line manager
 b. cannot possibly manage his project effectively
 c. both of the above
 d. neither of the above

Fill in the missing word or words.

17. A three-step approach to decision making is to ask

 a. What is the problem?

 b. ______________________________?

 c. ______________________________?

18. A ______________ manager has the responsibility for the day-to-day administration of personnel.

19. In assigning badges and special identification to employees, the project manager appeals to their need for ______________ .

20. Meetings are held to

 a. define problems

 b. ______________ c. ______________

Answer briefly.

21. What is the difference between the project manager's role in the conception and definition phases and his role in the acquisition phase? ______________________________

____

____

____

____

22. List the six basic rules for establishing up the line cooperation.

23. What are the special problems of a project manager who has only staff authority?

24. What is the main advantage of keeping personnel administration under the control of a functional manager?

25. What kinds of threats might the prospect of working on a new project pose to a potential employee?

26. List some of the ground rules for conducting successful meetings.

Answers to Chapter 5 Progress Check

1. T 2. T 3. F 4. T 5. F 6. T 7. T 8. T

9. d 10. a 11. b 12. c 13. c 14. d 15. d 16. d

17. b. What are the alternatives? c. Which alternative is best?

18. functional (or personnel)

19. status

20. b. spread information c. plan

21. Once the acquisition phase begins, the project manager's job changes considerably. Setting up a project is a relatively straightforward, logical supportive procedure. In contrast to this, the day-to-day solution of unforeseen problems in production requires different management styles that are much more directive.

22. The six basic rules for establishing up-the-line cooperation are:

    a. Know your own project and also related projects.

    b. Pass all pertinent information along to people in high places.

    c. Know your contacts.

    d. Be agressive – but never lose your sense of values or humor.

    e. Distinguish between the important and the unimportant.

    f. Adjust the level of your briefings to the level of your audience.

23. The project manager who has only staff authority must constantly refer back to his principal line supervisor for authority. Essentially he is without all the autonomy he could use to perform his job efficiently. Consequently, it may take him longer to complete a project than it would if he had line authority.

24. The main advantage of keeping personnel administration under the control of a functional manager is that it permits part-time personnel to be easily drawn from and returned to the organizational pool.

25. At the prospect of going to work on a new project, an employee might feel a threat to his established job status; a threat to economic security, a threat to comfortable, established ways of doing things; a threat to interpersonal relationships; or a threat to accepted and established lines of authority.

26. Some ground rules for conducting successful meetings are:

Be sure you pick the right people to attend.

Inform people in advance of what is to be discussed – perhaps by issuing an agenda.

Unless absolutely necessary, resist the temptation to dominate the entire meeting.

Attempt to ensure that the most junior of those attending participate – especially at planned meetings.

Once the facts have been assembled and a direction set, assign one person to follow through.

Sum up verbally what the meeting has done and then document it.

6 PROJECT MANAGEMENT
Dollars, Their Uses and Effects

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DOLLARS, THEIR USES AND EFFECTS

Learning Objectives

After finishing this chapter, you should be able to:

- Contrast the nature and purpose of an original estimate with that of a revised estimate.
- Describe the main functions of a project financial director.
- List the steps to be followed in budgeting and funding a project.

Reviewing Quiz

Check the box before each statement that accurately portrays the process of quotation preparation discussed earlier in this course.

☐ 1. The quality control manager sets up an inspection plan outlining inspection points and techniques.

☐ 2. He quotes the number of hours and the expected supporting costs necessary to satisfy the requirements of his plan.

☐ 3. The project manager or someone appointed by him adds this input to other inputs – for example, those of the systems engineer and the production manager.

☐ 4. The total cost package is fitted into the quotation in accordance with one of the control techniques described earlier in this course.

☐ 5. The result, therefore, is a logically quoted plan for task completion and fund expenditure.

☐ 6. Everyone may reasonably expect that, if the contract is won, funds will be laid out in exact accordance with the quoted plan.

Reviewing Quiz

You should have checked the first five boxes; a project quotation is built up using logical inputs from the project personnel who are to do the jobs.

You should not have checked the last box. You will discover why as you read further into this chapter.

The Adjustment of the Original Quotation

Focusing Quiz

There are a number of reasons why, once the contract is won, the funds might not be laid out according to the quoted plan. Read the following statements carefully. Circle those that you feel supply good reasons why a quotation might be altered.

1. The final price may be affected by marketing estimates of potential competition.

2. The final price may be affected by management projections of future changes in organization overhead.

3. The final price may be affected by a management decision to "buy into" a potentially profitable project.

4. The final price may be altered by the customer's changes in specifications.

5. The quote on a project is altered in order to include an unrelated project but one that the project manager views as a favorite and that he knows could be hidden in the current project.

As you discovered from the focusing quiz, the finally agreed-on contract price may vary considerably from the original quotation. It is necessary more or less to repeat the original estimating process and to build a project plan, but with one significant difference. When the original estimate was being prepared, each element of the quotation was fixed and the final price was adjusted either by the seller's management or the customer's negotiations. With the revised estimate, the total number of project dollars is fixed, and the breakdown of tasks with its allocation of dollars becomes more variable. Of course, there are limits to the variability of tasks. For example, the quotation may have included the cost of monthly visits to vendors by quality assurance

---

Focusing Quiz

You should have circled the first four statements. Item 5 is an unacceptable reason for changing the quote, because it suggests confusing the issue as to project management. Such a change might distort what an area of responsibility is and what the cost is that would be directly associated with the desired results. If an additional project needs to be funded, it should be handled on its own and clearly defined as such. Costs should not be included with an unrelated project.

personnel to ensure adherence to specifications. With a decrease in funds for quality use, it might be wise to schedule quarterly visits and detailed monthly written reports supplied by the vendor's quality personnel for the project manager's review. On the other hand, the cost for material may be somewhat inflexible. Even this, however, will not be totally inflexible, as the purchasing agent will explain. A vendor's price has been known to change when a purchase order is immediately available, as opposed to the price quoted when a request for quotation is received.

In addition to the obvious reason for the price change, that of ensuring the receipt of the purchase order, in some cases a sudden unexpected variation in a vendor's material costs, labor availability, or plant capacity, may cause a change.

Reviewing Quiz

Partly because of price changes, then, the revised estimate may differ from the original. Recall how as you draw lines to connect each kind of estimate (on the left) with its description (on the right).

1. Original estimate

2. Revised estimate

A The total number of project dollars is fixed, and the breakdown of tasks with its allocation of dollars is variable.

B Each element of the quotation is fixed, and the final price is adjusted, either by management or the customer.

The Value of a Project Financial Director

Evaluating risk and manipulating dollar reserves

In preparing the revised estimate, the financial director is one of the most important of project personnel. Immediately after project contract award, he subtracts profit, general and administrative charges, and a reserve for contingency, on which both the project manager and he agree. This reserve is dependent upon the manager's evaluation of the project risks. These will probably be much greater for a development project than for a production project. A high material content in the project would also indicate a lower reserve because the manager is more sure of the final project costs. Once the manager has placed a

Reviewing Quiz 1. B 2. A

purchase order, the vendor, at his own expense, repairs or replaces defective material. On the other hand, a high labor content should indicate a higher reserve. Development tasks and labor suggest increasing reserves. Long-term production and a high proportion of fixed-cost material suggest decreasing reserves. A formula that might be applicable is

$$\text{Reserve} = K \frac{(\text{labor})\,(\text{development costs})}{(\text{material})\,(\text{production quantity})}$$

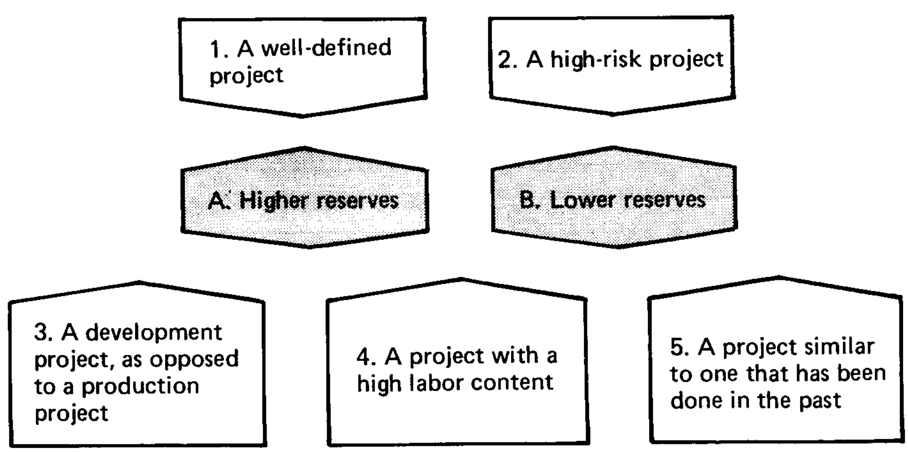
where K is some dollar constant established by similar projects.

Budgeting the project is, to some extent, a subjective procedure.

How this total project dollar package is broken down depends partly on the manager's opinion of the subordinate project personnel's ability to control funds and partly upon the complexity of the task to be funded. The financial director must understand and agree with the manager's evaluation and be willing to cooperate in the implementation of that judgment. Assuming that the total engineering task consists of design, documentation, and technical liaison and it is the manager's opinion that the systems engineer is oriented strictly toward technical competence, it may be wise to fund (or budget) each subtask separately. Monitoring three small subtasks is safer financially but more work administratively. Because the financial director is affected by this decision through his monitoring function, his opinion should concur with the manager's. Conversely, if the systems engineer is qualified administratively as well as technically, it might be better (and certainly easier from the financial director's viewpoint) to fund the total engineering task at once.

Reviewing Quiz

Consider what you have just read about the financial director's role in establishing reserves. Then draw lines to connect each of the following two kinds of project (shaded boxes) with the relative amount of reserves (white boxes) that project would call for.



Draw lines to connect each of the following operational procedures (on the left) with the kind of section manager for whom those procedures would better apply.

6. Break the task down into subtasks. Fund and monitor each subtask separately.	A The section manager is both technically and administratively qualified.
7. Fund and monitor each task as an entity.	B The section manager is technically but not administratively qualified.

Incident

Interactive Time Sharing: Trimming a budget may involve some unexpected evaluations

You may find that the Reviewing Quiz you just completed contains clues to solving the problem presented in the following incident.

In early November, Bud Richards, project manager for a new set of computer programs at Interactive Time Sharing, had worked out a proposed budget for his project that included a substantial reserve to cover uncertainties connected with total cost requirements. Most of these uncertainties were due to the fact that the programs being developed were in a new area for the company and required the skill of some outside programmers as well as support from Interactive's regular staff.

Not long after the project was underway, the Marketing Department approached Bud and indicated that in order to be competitive on this set of programs, they were going to have to cut the budget substantially. Bud's initial reaction was to apply a large part of that cut to the substantial financial reserves that had been built into the initial quote. However, Tim Simpson, the financial director, was most reluctant to cut that reserve at all. It was Tim's feeling that given the newness of the project, the fact that outside programmers were involved, and the kinds of skills required, that substantial reserves would be needed.

Bud realized that his only option other than the reserves was to try and bring more of the work in-house. This would mean relying on his own staff, which he did not feel had the full range of capabilities that some of the potential subcontractors had. Thus, while he felt they might be able to do it in-house, he was not sure the resulting set of programs would be as good as would otherwise be the case and in fact he felt they might be more costly to run because they would have been developed in a less efficient form.

Reviewing Quiz 1. B 2. A 3. A 4. A 5. B 6. B 7. A

If you were Bud Richards, would you have requested that the financial director reduce the reserve on this project? Why or why not?

See response to Incident at the bottom of page 9

Planning — Budgeting and Funding

The original quotation is the logical point at which to begin allocation of funds. A tabular layout of original quotation tasks should then be compared with the projected actual tasks.

Original project – design development, and delivery of 100 widgets

A real quotation may have either more or less detail than this one, depending on the product and the customer the project serves.

Notice that the factory cost is multiplied by 110% to get the G&A plus factory cost. This figure is then multiplied by 110% to get the G&A plus price.

		Original Quotation		
Task No.	Task Description	Material	Labor Hours	Labor Dollars (including overhead)
I	Engineering evaluation	$ 100	200	$ 3,000
II	Design and documentation	500	500	6,000
III	Inspect material–100 widgets	5000	100	1,200
IV	Design and build tooling	1000	100	1,200
V	Manufacture and test first lot – 25 pieces	––	2500	22,500
VI	Manufacture and test second lot – 75 pieces	––	6750	60,750
VII	Project management	500	500	9,000
		$7100		$103,650

$ 7,100	
103,650	
$110,750	factory cost
$121,825	G & A@ 10% (This G & A figure has been set up by the company, as has the profit percentage.)
$134,008	profit @ 10% = quoted price

For simplification, this quotation makes several assumptions:

1. Even though each task may have several categories of labor (Task I may have detailers and checkers at different labor rates), labor is either engineering at $5 per hour, management at $6 per hour, production at $3 per hour, inspection at $4 per hour, or design at $4 per hour.

2. Overhead is 200 per cent and the same for all departments.

3. A Gantt (or milestone) chart, showing when the various types of labor will be required, has been drawn and is still valid.

4. The first 25 widgets will take 100 hours each to manufacture and test; the second lot of 75 widgets will take 90 hours each to manufacture and test.

Because of changes in pricing or negotiation, the final price is $130,000.

Assume that both the manager and the financial director agree that a $30 reserve per widget is required.

Notice that each of the first two reductions is achieved by dividing the figure above it by 110%.

Contract price	$130,000
Less profit @ 10%	118,100
Less G & A @10%	107,400
Less reserve @ $30 each	$104,400

Incident

One of the things that the project manager must keep in mind in trimming a budget is that it must be done in such a way that it most efficiently reduces overall costs. In this case, Bud Richards may be able to trim the budget by bringing more of the work in-house, although this may result in larger operating costs once the new set of programs is developed. Thus, while such a change may meet the requirements for a smaller budget, in the long run it may be much more costly to the company. If Bud really believes this, then he should in fact make it clear and go back to the financial director and get his support for trying to cut the reserves if that looks like the more effective way to meet the budget.

We therefore now have a total budgeted figure of $104,400 to complete a project that was estimated at $110,750. The savings of $6,350 must come out of the quoted program.

Savings can generally be targeted in high-value tasks more easily than in low-value tasks.

- Internal negotiations with your production manager result in his agreeing to deduct three hours each from the 75-piece lot and four hours each from the 25-piece lot.
- The purchasing group feels that they can save $8.75 on material costs.
- Engineering drafting will cut 100 hours from their estimate.
- Systems engineering has found some applicable data that they were unaware of during the quotation and can therefore cut their quotation by 50 hours.
- Tooling design will cut by 50 hours.

In actuality, it may not be quite so easy to cut costs.

At this point it is not necessary to cut back on project management; however, if required to meet budget it might be necessary.

	Original			Budget		
Task	Material	Hours	Labor Dollars	Material	Hours	Labor Dollars
I	$ 100	200	$ 3,000	$ 100	150	$ 2,250
II	500	500	6,000	500	400	4,800
III	5000	100	1,200	4125	100	1,200
IV	1000	100	1,200	1000	50	600
V	–	2500	22,500	–	2400	21,600
VI	–	6750	60,750	–	6525	58,725
VII	500	500	9,000	500	–	9,000
	$7100		$103,650	$6225		$98,175

	Original	Budget
Costs –	$103,650	$ 98,175
	7,100	6,225
	$110,750	$104,400

Incident

Creative Studios: trimming a budget to secure a customer

Cutting costs on a widgets project may or may not present the same problems as cutting costs on a different kind of project. Apply as much as you can of what you have just read, as well as your own judgment, in solving the cost-reduction problems presented in the following incident.

Shortly after Jim Shank completed his proposal for developing the TV special requested by one of the major networks, he was told that his budget would have to be trimmed. Jim's original budget had totalled $325,000. It had consisted of the following elements:

Payment to actors	$80,000
Scenery	70,000
Production crew	40,000
Materials, costumes, etc.	65,000
Overhead	20,000
Profit before tax	50,000

The Marketing Department had informed Jim that the contract could be won at a price of $280,000. Because marketing was anxious to do business with the major network involved and also the sponsor of this particular project, they had gone ahead and committed Creative Studios to a total price of $280,000. Top management had then directed Jim that they would be willing to cut their profit before tax to $25,000 but that the other $20,000 would have to come out of some of the other areas included in his original budget.

How would you recommend that Jim Shank approach the task of realigning his budget?

Incident

The first step that Jim might take would be to determine just what the constraints are and the possible ranges for each of the components in his cost structure. Since the actors are unionized and the sponsor and network probably have some preferences for certain actors, he would probably find that this cost may be difficult to vary. However, it may be that costs such as scenery and materials and costumes could be reduced by changing proposed formats and using items out of the current inventory at Creative Studios. The production crew and overhead figures are probably fairly fixed for this operation. Even if they could be reduced, it may affect the quality of the production. Thus it appears in this situation that working with the scenery costs and the materials and costume costs would be the best source for Jim in cutting his budget by the additional $20,000.

Let us now return to our example of the widgets. After necessary savings have been promised by various project sections, funds should be allocated for each project task. Every task should have its own cost control number and rate of expenditure; each will be monitored by the financial director. Any deviation from plan expenditure and/or accomplishment should be the cause of an immediate investigation and correction. The reserve should be allocated only when required.

A sample format follows:

Figure 1

Format for presenting planned and actual costs

Task Number	Task Description	Supervisor
I	Engineering evaluation	J. Engen

Date Open	Date Close	This Report Date
9/1/75	11/1/75	10/1/75

Time Period	September Plan	September Actual	Cumulative Plan	Cumulative Actual	October Plan	October Actual	Cumulative Plan
Labor Hours	75	75	75	75	75		150
Labor Dollars	$1,125	1,125	1,125	1,125	1,125		2,250
Material Dollars	$50	0	50	0	50		100

This format is simplified and designed for one-man control. More formalized controls extending even into computer inputs can be used in larger projects. This particular format has several advantages. It shows rate of expenditure, the date the job begins and the date it stops. At a particular point in time, Oct. 1, 1975 for example, the engineering labor is meeting the plan, but the material has not yet been spent.

Reviewing Quiz

In the preceding discussion, it has been suggested that the project manager follow certain steps in budgeting and funding the project. These steps appear below, but in the wrong order. Indicate their proper order by filling in the appropriate boxes with the numbers 1 (for the first step) through 5 (for the last).

☐ Compare the production cost estimated on the original quotation with the projected actual production cost.

☐ Allocate funds for each task, allowing for a reserve.

☐ If necessary, find tasks whose costs can be cut from their quoted costs.

☐ Establish the contract price.

☐ Calculate the actual budget you will have to work with.

The following checklist contains advice about keeping track of costs. Cross out any bad advice.

✓ Each task should have its own rate of expenditure.

✓ Each task should have its own cost control number.

✓ The financial director should monitor expenditures for each task.

✓ Any deviation from planned expenditures should be investigated at once.

✓ Any deviation from planned expenditures should be corrected as soon as possible.

✓ Reserve funds should be allocated only when absolutely necessary.

Expenditure rate — feedback control

When plotted against time, the total cost of the seven tasks of the widget project we have been discussing is the number of dollars required at any point to allow project operation. The project rate of expenditure of funds is always matched against project accomplishment. It does no good to know that the funds are being spent at the correct rate if the tasks are not being completed at the correct rate. In addition, no project is a static system; as time goes on, design breakthrough or unforeseen problems may affect progress. The three requirements needed to ensure control are the following:

Meeting a planned expenditure rate

Accomplishing planned milestones

Calculating estimates-to-complete (ETC)

The third requirement is important because each task leader must take into account all progress made on his task and estimate the number of dollars needed for completion. Although it rarely happens, an estimate-to-complete may show completion for less than planned

---

Reviewing Quiz

You should have filled in the boxes in the following order: 3, 5, 4, 1, 2.

You should not have crossed out any of the items on the checklist. Each is good advice about keeping track of costs.

costs, but generally an ETC will meet or exceed plan. After a thorough evaluation, and if no other recourse is available, the $30 reserve per widget might now be needed if the project runs into an unforeseen problem. This reserve should be used only when all other sources of funds in unused tasks have been exhausted.

Reviewing Quiz

From what you have just read, you should know which of the following sets of conditions you ought to be able to determine through feedback control. Circle each such set of conditions.

1. The rate of expenditure is too rapid, and the rate of completion is on schedule.

2. The rate of expenditure is on schedule, and the rate of completion is too low.

3. The rate of expenditure and the rate of completion are both on schedule.

4. The rate of expenditure is too high, and the rate of completion is ahead of schedule.

5. The rate of expenditure and the rate of completion are both behind schedule.

Projected financial effects of changes

As we have indicated throughout this chapter, the project exists and operates in great measure due to financial considerations. The financial director (comptroller, or project control assistant, or whatever his title is) must be aware of project plans and changes. He is able to project any financial effect of a change in design, an overtime schedule to expedite delivery, or any other contemplated project change. He is a vital part of the intra-project information loop. As an attendee at all project meetings, his constant attitude of "How much will it cost?" serves as a useful deterrent to incompletely thought out proposals. His responsibilities include the following:

A summary of the financial director's responsibilities

- Evaluating estimates.
- Identifying financial differences between actuality and plans.
- Requiring that project supervisory personnel supply "estimates-to-complete" at periodic intervals (such as 50 per cent budget expenditure point) or whenever a special need arises.

Reviewing Quiz

You should have circled all five items. You should be able to determine each of these sets of conditions through feedback control.

- Finally, and most importantly – establishing controls that prevent any expenditures not in accordance with approved plans. This applies not only to original plans but also to any changes in plans.

Finances Versus Ethics in Operations

To review: many of the problems that face the project manager eventually become financial in nature. At that point he can solve them with the assistance of the financial director. To return to the example of the widgets: The project manager and the financial director had mutually agreed upon a $30 per widget reserve fund, which was set aside for project emergencies. Without the financial director's concurrence, this fund would probably have been very difficult to establish. His "spiritual leader" is someone in the finance group, and from their viewpoint it would be more plausible to increase project profit if there were reserves available rather than to establish an emergency fund. But not all decisions regarding money are as strictly financial as this one.

There will also be occasions when funds must be spent that are not contractually required. These occasions will involve ethical decisions, and the financial director's approval can then be even more important. Any expenditures needed to fulfill a contractual obligation that is expressly outlined by the contract would never be questioned. On the other hand, the obligations that are implied or that are not implied but are in the manager's opinion equitable could lead to serious problems.

Most of these problems become important because they are tied to some financial consideration. Solving them equitably can be difficult, especially if the amount of money involved is large and the manager's decision favors spending rather than retaining funds for an increase in profit. These problems exist outside the framework of law. An outright case of fraudulent timekeeping poses no great decisional crisis. It is illegal and should be handled that way. The law, however, allows a wide latitude of action in a gray (that is, neither absolutely right nor absolutely wrong) area in which each one must decide for himself.

Incident

The following incident describes one such gray area.

The deal looked good, and Ned breathed a sigh of relief when the president of Commercial Firm penned the contract calling for Ned to deliver 100 widgets in five months time. Production went ahead full steam. It looked as though Ned's project might complete its work a full week ahead of schedule. But then, halfway through the contract, the news came: the customer informed Ned that his marketing picture had changed and he would only need 50 widgets. Ned was upset about this at first, but calmed down when the customer agreed to pay $20,000 for work done on the 50 incomplete widgets, and to let Ned keep those widgets in the bargain. Everyone was satisfied; the matter was ended. Or was it?

Six months later Commercial Firm came back with an order for 50 widgets. They strongly suggested that Ned's firm give them the $20,000 credit. Ned knew he had no legal obligation to do this. Still, he felt uncertain about what to do.

How would you have proceeded if you were Ned?

____

____

____

____

____

The following list contains a valid procedure for making decisions such as the one described in the preceding Incident. Check each item that you had in mind as you wrote in your solution.

☐ 1. Attempt to disassociate yourself from the problem and look at it from a "disinterested third party" point of view. If possible, look at it from a "What's best for both parties?" attitude.

☐ 2. Document the problem, your reasoning and solution (or solutions) and file it away for as long a period of time as the problem will permit. Then re-examine your documented position to see if you have new insights. Attempt to obtain the financial director's concurrence with your solution.

☐ 3. Consult with management and obtain their opinions.

Incident

We will not project a solution to this incident. We include it here only to illustrate the kinds of situation in which a project manager must weigh the financial against the ethical.

☐ 4. Distribute your documented decision to interested project and management personnel.

> The ethical actions and conduct of the project manager may seem impeccable to those with whom he is in daily contact, but decisions involving money can be subjected to later misinterpretation unless they are completely documented. Even then it is sometimes possible to read between the lines, but when there are no lines to read between, or not enough lines, the possibility of misinterpretation increases greatly.

Summary of Chapter 6

The financial director is one of the project manager's closest allies. He assists in setting up project tasks, monitoring progress, and identifying differences between plan and actuality. His questions about the cost of a prospective change must be satisfied before any changes are approved.

Financial considerations may involve ethics. Many such decisions are not covered by legal precedents which could have served, as in common law, as a published guide; therefore, complete documentation of such decisions is a vital necessity.

Chapter 6 Progress Check

Draw lines to connect each statement about an estimate (on the left) with the kind of estimate to which it applies (on the right).

1. The total cost is fixed.
2. The total cost is variable.
3. The task breakdown is fixed.
4. The task breakdown is variable.

a. Original estimate

b. Revised estimate

Cross out the word that does not apply.

5. The reserve for a development project would be (greater/less) than the reserve for a production project.
6. The reserve for a project with a high material content would be (greater/less) than the reserve for a project with a low material content.
7. The reserve for a project with a high labor content would be (greater/less) than the reserve for a project with a low labor content.
8. The reserve for a long-term production project would be proportionately (greater/less) than the reserve for a short-term production project.
9. If the section manager of a task (were/were not) administratively qualified, the financial director might recommend breaking that task down into subtasks, which he would then fund and monitor separately.
10. The more ethical the nature of a project manager's decision, the (more/less) important it is for him to document it.

Fill in the missing word or words.

11. $$\text{Reserve} = K \, \frac{(\qquad\qquad\qquad\qquad)\ \text{(development costs)}}{(\qquad\qquad\qquad\qquad)\ \text{(production quantity)}}$$

12. A feedback control system should be a tool with which the project manager and financial director can measure the rate of ______________ and the rate of ______________ .

Indicate true (T) or false (F).

13. How the total project dollar package is broken down depends partly on the project manager's opinion of the ability of subordinate personnel to control funds. ____

14. The project dollar breakdown also depends on the complexity of the task to be funded. ____

15. The original quotation should be disregarded once a contract has been signed. ____

16. Internal negotiation should not be used to reduce project costs. ____

17. Management support costs should not be cut in order to meet a budget. ____

18. Each task should have its own cost control number. ____

19. The project manager is on his own in making ethical decisions; he should not consult top management. ____

20. Any deviation from planned expenditure should be the cause of immediate investigation. ____

Answer briefly.

21. Why might it be necessary to revise an original estimate after a contract has been won?

22. What are the main functions of a project financial director?

23. What are the five steps to be followed in budgeting and funding a project?

Answers to Chapter 6 Progress Check

1. b 2. a 3. a 4. b

5. greater 6. less 7. greater 8. less 9. were not 10. more

11. labor (in the numerator); material (in the denominator)

12. expenditure, completion

13. T 14. T 15. F 16. F 17. F 18. T 19. F 20. T

21. It might be necessary to revise an original estimate after a contract has been won if the final price were to be affected by

    Marketing estimates of potential competition

    Management projections of future changes in organization or overhead

    Management decisions to buy into a potentially profitable project

    Customer changes in specifications

22. The main functions of a project financial director include:

    Evaluating estimates

    Identifying financial differences between actuality and plans

    Requiring that project supervisory personnel supply ETC at periodic intervals

    Establishing controls that prevent any expenditure not in accordance with approved plans

23. Five steps to follow in funding a project are:

    1. Establish the contract price.
    2. Calculate the actual budget you will have to work with.
    3. Compare the production cost estimated on the original quotation with the projected actual production cost.
    4. If necessary, find tasks whose costs can be cut from their quoted costs.
    5. Allocate funds for each task, allowing for a reserve.

International Association of Information Engineers

With the planned annual convention of the International Association of Information Engineers only two months away, Mary Stafford, the project financial director for the convention, found herself in a tight spot. When she had first been assigned to work on the convention, everybody was talking about a huge extravaganza. In fact, they had made commitments with the major hotel complex to use their largest auditorium for an equipment show and to use several of their conference rooms for individual sessions that would run concurrently. Additionally, they had reserved substantial amounts of space in the hotel and arranged for several large luncheon and dinner meetings.

The Association had been required to make a firm commitment to the hotel some months earlier but had managed to make an agreement that allowed them to reduce the size of that commitment if they ascertained within 60 days of the start of the convention that their original estimates had been overly optimistic. Mary had now reached the point where she had to make a final commitment to the hotel. In reassessing the projection of the number of participants and size of the overall convention, she found that they had been overly optimistic in the early stages. It now appeared that they would only have about half as many people in attendance as had been originally planned. This meant that Mary and the project team would have to cut their budget substantially and make the necessary cuts in some of the planned activities.

One of the special problems that this created was that it was no longer practical to rent the largest auditorium available at the hotel complex for the equipment show. Rather they were going to have to go with a smaller auditorium that would only hold about 40% as many booths. One of the special problems this created was that in order to fill the large auditorium, she had signed some early agreements with equipment vendors, some of whom would not be her first choice if she did not have as much space as originally planned. Thus one of her dilemmas was whether or not she should try to keep these vendors from exhibiting at the show and still seek last-minute agreements with some that she thought would be more attractive from the Association's point of view. She realized that this would create some hard feelings in the industry, but she also felt some pressure from the executive committee to have the best representatives possible at the equipment show.

At this point she was reviewing what she might have done differently early on to avoid some of these problems and was also trying to determine what she was now going to do.

Assignment

How might Mary Stafford have improved her planning?

International Association of Information Engineers

Perhaps Mary Stafford's biggest oversight as project financial director was not developing contingency plans so that she could remain flexible until a final commitment was actually required. Having made some early commitments to both the hotel and individual equipment vendors, it now appears that she must honor those even though it may mean that conditions will not be ideal at the convention. Instead what she will need to do is perhaps set up some alternative ways to offset these weaknesses in the convention. This might include renting a second, smaller hall for the equipment vendors who cannot be accommodated in the hotel itself.

At this point she really needs to work out revenue projections based on inputs from other members of the project team and from the executive committee and then get the executive committee's commitment to provide the best possible convention given those projections. From that point, Mary can then develop cost estimates of the various portions of the convention and work out a complete financial plan that will be acceptable to the Association and to those attending the convention.

7 PROJECT MANAGEMENT

Systems Engineering

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7

SYSTEMS ENGINEERING

Learning Objectives

After finishing this chapter, you should be able to:

- Describe the nature and scope of systems engineering on a project.
- Describe the nature and scope of each of the four components of systems engineering.
- Describe the three basic kinds of data and the functions of each.

Reviewing Quiz

Before proceeding with the text, take this opportunity to review what you have already read. Check the box before each statement that accurately portrays a way of managing a technical project that is consistent with what has been taught in this course.

☐ 1. Before establishing the project, there is a minimal expenditure of management thought and engineering design to meet the customer's proposed requirements.

☐ 2. These customer requirements may include design criteria for a system that his design engineers think will satisfy his needs.

☐ 3. These data may have been given to a number of other vendors besides yourself.

☐ 4. Your top management turns the requirements over to its engineering group.

☐ 5. The engineering group designs a system that appears to be satisfactory. Management judges the design important enough to justify setting up a project for it.

☐ 6. A project manager is appointed. He organizes a team and plans the formation of the quotation.

☐ 7. Successful negotiations are conducted. This means the deal is favorable to you, regardless of how the customer feels about it.

☐ 8. The project manager outlines his financial requirements and sets up internal controls.

☐ 9. The goal of the project is clearly defined; It is solely to build hardware to specifications to which the customer has agreed.

Systems Engineering Defined

Key Term

Systems Engineering

A discipline that provides a complete design to the satisfaction of the customer.

Although the preceding definition may lead one to believe that the systems engineering task is straightforward, in practice it can be a tremendous effort. Such activities (defined later in this chapter) as configuration management, data management, and logistics support must be completed in order, for example, to provide a useful operating hydraulics control that has been fairly well defined by the design engineers. The systems engineering task has a wide variability depending upon the product and the industry in which the product is used.

Analyzing Quiz

If you have ever tried to assemble a new bike under the watchful eye of a young child, you may have a special interest in this example.

Consumer industries in general could stand a lot more systems engineering. From what you have read about systems engineering so far, can you figure out what this might entail? Circle each of the following subtasks that might be considered part of the systems engineering of a new bicycle.

1. An instruction sheet showing how to assemble the bike

Reviewing Quiz

You should have checked all the boxes except those before items 1, 7, and 9. You should not have checked item 1, because, as the succeeding items imply, a great deal of expenditure of management thought and engineering design is required to launch a project such as this one. Item 7 is incorrect, because, as discussed earlier in this course, a "good deal" is one in which both the seller and the buyer feel their objectives have been satisfactorily met. Item 9 is also incorrect. The goal of a project such as this one is not only to build hardware to satisfy the customer's needs. It is also to support this hardware with such things as test procedures, repair manuals, spare parts, blueprints, operation and instruction documents, and in general to provide a complete system for the use of the hardware. This chapter focuses on the creation of such systems.

2. Directions as to when and where to grease the bike

3. Instructions about how much air to put in the tires

4. A sketch showing how the parts fit together

5. A plan to package and label different kinds of nuts and bolts separately

6. A description of the chemical constituents of the bike's parts

7. A description of the type of steel used

Circle each of the following subtasks that might be considered part of the systems engineering of a new municipal steam generating plant.

In completing this part of the quiz, keep in mind that the systems engineer of a municipal engineering plant would have a much greater responsibility for systems completeness than would, for example, a bicycle designer. To understand why, consider the nature of the former's customer – an entire population – and the effects of a steam plant's malfunctioning.

1. The choice of plant location

2. The construction of the plant

3. Maintenance and operations manuals

4. Supervision of vendor's products in manufacturing

5. Life testing of vital components

6. Treatment of water supply

7. Specifications for fuel supply

8. Training of operating personnel

9. Field servicing of equipment for several years to make sure it is debugged

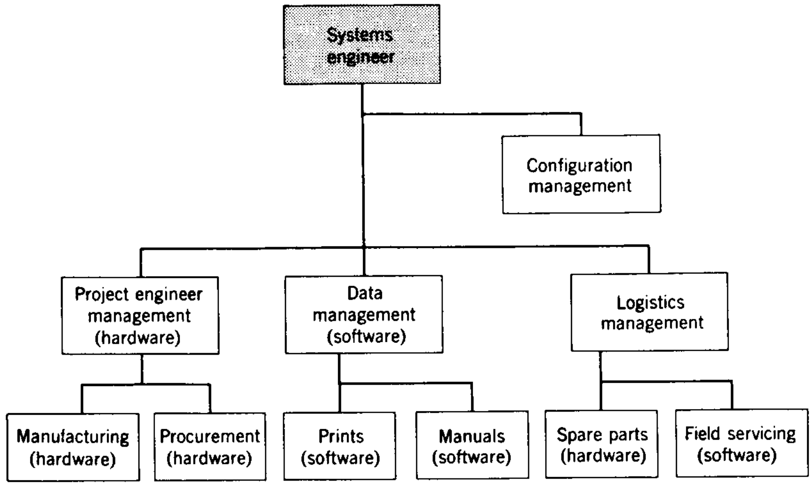
Analyzing Quiz

You should have circled the first five items for the bicycle example and all the items for the steam generating plant example. In the latter example, items 1 and 2 are included because the choice of plant location and the construction of the plant to meet the requirements of that location are important elements in coming up with a design that meets the customer's satisfaction. (Recall the definition of systems engineering.)

The hydraulics control systems engineer we have been discussing has a structured task to complete. This structure may appear as the organization represented in Figure 1.

Figure 1

An example of a systems engineering structure



This structure is a device through which the systems engineer can direct the engineering process during the system life cycle. Although all these tasks had been quoted during the proposal stage of the project, the hardware quotation of the project engineer was the prime reason that the company received the contract. Everyone was aware of this, and because of that awareness, there could be a tendency to assign the software or data generating tasks to a less important status. Such action could result in project failure as readily as could a major mathematical miscalculation in the project engineer's hardware design. For example, if the manual is written without thought given to the abilities and training of the eventual user, the manual writer may feel that "everyone knows that you should disconnect the electrical power source before changing a fuse" and therefore not include this simple warning. Such an assumption could lead to loss of life.

The systems engineer uses his systems structure:

- To identify the technical and economic variable tradeoffs
- To determine systems functions and sequence
- To design requirements imposed by functions
- To select the best complete approach for systems production
- To ensure that a usable system (as defined by the customer) is delivered.

The last point is most important, since all of the supporting tasks must consider the degree of sophistication of the eventual user.

Incident

First National Bank: Site development

Consider the above list as you examine the following incident.

Ned Cantey had recently been assigned as the systems engineer for the development of a new branch bank in one of First National Bank's target suburbs. As a start in tackling his assignment, Ned had identified several areas in which he needed to define parameters of the branch. These included such items as location, size, services to be offered, layout, architectural design, timetable for development, and budget for development.

In mapping out his plan, he wanted to be sure to identify the specific tasks that would be required in each of these areas, the costs associated with those tasks, and the sequence in which they needed to be carried out. He felt this would allow him to develop benchmark goals so that he could pace his own progress and subsequently monitor the progress of the actual development.

Has Ned considered the most important items in his situation? How would you evaluate his approach?

Incident

Three areas that are not included on Ned's list that would be of major importance are staffing (developing a complete staff for the new branch), marketing objectives for that area, and corporate policies relevant to the development of new branches. In terms of the sequence in which he might approach his task, the structure that Ned should follow would be 1) identifying the technical and economic variables and their tradeoffs, 2) determining the functions of the system and its desired capacity, 3) incorporating the functions into the basic design, developing a complete project development plan to accomplish that design, and 4) implementing controls to monitor adherence to the project plan and its completion as desired.

Components of Systems Engineering

Four basic components of systems engineering are configuration management, project engineering, logistics management, and data management. We shall discuss each in turn.

Key Term

This definition comes from AFSCM 375-3, Systems Management Manual, *June 15, 1964, page 38.*

Configuration Management

"A procedural concept controlling technical requirements through documentation, which is standardized for both producer and user of the system."

Every applicable technical facet of the project from inception to conclusion must fit into some type of drawing-data control system. If we use the hydraulics control system example, configuration management would probably begin with the performance requirements and design criteria that describe what the project is to develop in the completed system. This document could be in the form of a narrative description such as a specification, or in the form of a "black-box" drawing that would simply show inputs and outputs. (We are assuming that this system is part of a larger system.) The proposal assembly drawing of the controls and probably several major subassembly drawings might complete the initial project configuration management data.

Let us now make several assumptions about how drawings are handled in the seller's organization.

1. There is a procedure for drawing control and numbering.

2. There is a drawing standards manual that outlines the sizes and types of drawings to be produced.

3. There is a formal engineering drawing change procedure that involves and informs every major section of the program, from quality control through production, before a drawing can be altered.

4. There are several separate check-off points and approvals of a drawing within the engineering technical group that must be completed before an original drawing is released for production. This could preclude, for example, a mechanically correct but electrically incorrect drawing from being released.

Each drawing approval would pertain to a specific drawing content.

Drawing-data controls, on the other hand, can be relatively informal. The bicycle manufacturer surely is not going to document his tire requirements beyond the bill of materials, describing the tire size and color. An aircraft manufacturer would certainly go farther than this if he required aircraft tires. He would at least specify size, diameter, tolerance, material, color shade, weight, density, and a dozen other parameters to assure himself that every criteria which could affect the performance of this critical item had been adequately documented.

Configuration management is used to assure everyone that everything produced off a production line will be the same, unless a change is approved through the recognized and formalized procedure. The only constraint upon this procedure is that both the seller and the customer can understand it and work with it.

The customer does not necessarily have to use the same procedure, but he has to be able to use the seller's data in his organization in order to use the seller's product in the assembly of his next higher system. If the configuration management produces reams of blueprints and his information storage is based on microfilm, he will undoubtedly be able to transform the project information into microfilm. However, if the seller produces magnetic tapes and the customer either has no facilities for reading tapes or no desire to read them, the seller may have to change back to blueprints.

Reviewing Quiz

Each pair of statements about configuration management contains one statement that is accurate and one that is not. Shade in the box containing the accurate statement.

1.. All applicable technical facets of a project must fit into some type of drawing-data control system.	2. Configuration management is limited to the performance requirements and the design criteria describing the project.
3.. Drawing standards should be unique to each project, because each project is unique.	4. When possible, a drawing should be prepared according to organization standards.

5. Buyer and seller must use the same procedure for drawing-data control.	6. Buyer's and seller's procedures may be different, provided one can be converted to the other.
7. Drawing-data controls can be relatively informal on some projects.	8. Drawing-data controls must always be as thorough as posible.

Key Term

A second component of systems engineering

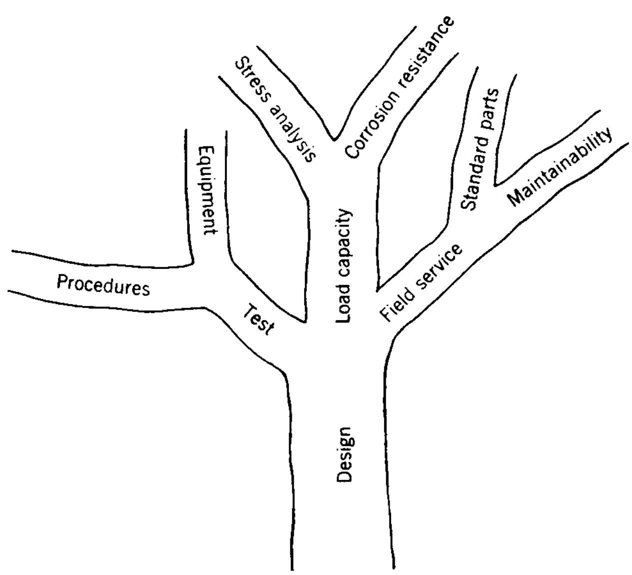
Project Engineering

The activity dealing with the coordination of the various developmental tasks and then with the implementation of the final design into the standard production process.

In a technical system, project engineering is basically concerned with hardware. The preliminary proposal identified the scope of the design. Limiting design parameters – and here we refer back to our example of the hydraulics control system – would include items such as shock limits, vibration amplitudes, operational life, size, weight, current drain, reaction time, pump pressure, and temperature environments to form the "trunk" of a design "tree" structure.

Figure 2

System design tree for a hydraulic system



Reviewing Quiz

You should have shaded in the boxes containing statements 1, 4, 6, and 7.

On separate starting but eventually intersecting "tree branches," the specialists in maintainability, for example, have been reviewing the design to be sure that the access holes are large enough for a man to insert his hands if repairs are required or that the hatch covers can be easily removed in the Arctic by a heavily bemittened hand if the product is to be used in that environment. The test engineers are designing semiautomated test procedures that can be run by ordinary consumer instead of requiring a highly trained technician. In effect, multiple hardware design is being carried on in parallel efforts. Even the procurement people are involved because they can offer suggestions with respect to less expensive but similar vendors' products.

Basically, the systems project engineer's responsibility is to resolve differences at design points where the parallel efforts approach each other and join the complete assembly. Then he directs the movement of the designed assembly to a technically acceptable solution. An example might be resolving a requirement for extended range against the weight penalty imposed by a sequential need for larger fuel tanks.

Reviewing Quiz

Cross out the group that would have no part in the project engineering of the hydraulics control system we have been discussing.

procurement personnel

test engineers

design engineers

industrial engineers

market analysts

Reviewing Quiz

You should not have crossed out any group. Each plays a part in project engineering.

Key Term

A third component of systems engineering

Logistics Management

A concurrent design-engineering activity concerned with supporting and maintaining the system after it has been delivered to the customer.

Focusing Quiz

How is the concept of logistics management applied? Keep in mind what you have already learned about project management and systems engineering as you read the following statements about logistics management. If you conclude a statement is untrue, cross it out.

1. Logistics management begins when production stops.

2. The minimization of complicated test equipment could be an aspect of logistics management.

3. The development of lists of spare parts could be an aspect of logistics management.

See answers at the bottom of page 13

Logistics management does not begin when production stops; rather, it starts at the project's inception. During conception and definition phases, there must be a continual effort to minimize special parts, distinctive assembly or repair tooling, and complicated test equipment. The logistics engineers are well aware of the problems that are eliminated when a field repair must be made quickly and in fact can be done with an ordinary screwdriver and pliers. They develop recommended lists of spare parts and projected field usage. They also supply services to the customer for start-up and field instruction. This activity can be a major effort as the system becomes larger. The startup, debugging, and customer services for a municipal steam-generating plant can be sizable. Those services for the bicycle are probably discharged by the jobber's salesman.

Key Term

A fourth component of systems engineering. This definition comes from AFSCM 375-3, Systems Management Manual, *June 15, 1964, p. 38.*

Data Management

The activity by which minimum essential documentation is acquired for system construction.

This data may be in any form that is convenient and utilitarian. Generally, in simpler systems the data is limited to blueprints, but it can, as it might in the case of our hydraulics control example, be a magnetic tape programmed for numerical control machining of a manifold. The degree of data complexity is almost proportional to the degree of system complexity and size.

This facet of systems engineering can be one of the more important ones. If the data management task is accomplished in an efficient manner, all subsequent activities are facilitated. An inadequate or inefficient data management engineer can be the cause of repeated failures. Prints with missing tolerances, prints that are revised without proper notification to the entire engineering group, or prints that are not revised as the design progresses are common causes of many systems failures.

Reviewing Quiz

Cross out the bad advice in the following data management checklist.

✓ 1. Once documents have been created, do not revise them.

✓ 2. Regard the main task of data management as the storage of documents in a safe place.

✓ 3. All documents for a given project should be in the same form.

Systems Data Requirements

Thus far we have discussed the uses of data without discussing the kinds of data. Data can be placed in three major classes: prints, procedures, and listings. We shall study each in turn.

Key Term

Prints

All the data that describe *what* a system is.

Prints may be divided into proprietary and specification control data. In manufacturing systems, *proprietary drawings* are designed or developed by the engineering group, which provides the specific

Focusing Quiz — You should have crossed out the first statement only.

Reviewing Quiz — You should have crossed out all three items.

information required to build the projected system. To return to our example of the hydraulics control: the housing casting layout, the tie-rod machining specifications, and the accumulator burst strength would all be part of the respective proprietary drawing.

Specification control drawings are those that show products already produced by other organizations. These products could, for example, be components or subsystems of your own system. If you required a certain valve already produced by the ABC Valve Corporation as part of the manifold, the specification control drawing would probably show outline and mounting dimensions and those other criteria necessary for correct operation of the ABC valve in the manifold. Pressure drop, burst strength, flow and weight are obvious items noted on the specification control drawing. These pertinent facts coupled with the ABC Valve Corporation model number should adequately describe the valve. It is wasteful to detail completely standard hardware or a component that someone else is already making more economically than you can.

Reviewing Quiz

Draw lines to connect the kind of print (on the left) with its definition (on the right).

1. Proprietary drawings	A Drawings that show products already produced by other organizations
2. Specification control drawings	B Drawings designed or developed by the project's engineering group

Key Term

A second kind of data

Procedures

All the data that describe *how* to use the system.

Procedures are the manuals for systems use, repair, and test. They may apply to minor components such as an internal proof test of a hydraulic accumulator. In this case, the project engineer may feel that the critical nature of this component required a 100 per cent test at 6000 psig. The detail print of the accumulator would show all the accumulator dimensions plus a reference to a 100 per cent test according to, say, test procedure No. 18. In turn, test procedure No. 18 would show a hydraulic pump, gages, test block, and acceptance criteria

Reviewing Quiz 1. B 2. A

in order to run an acceptable test. Procedures may also apply to the entire system use.

Key Term

A third kind of data

Listings

Compilations of prints, manuals, specifications, or any other information needed for a systems limitation.

A *Bill-of-Materials* is a listing of a system's detail parts sequenced in the way that the system is normally assembled. Using an accumulator assembly as an example, the Bill-of-Materials would show the following:

Item	Number	Number Required per system	Part Name
1100	1016340	1	Accumulator assembly
1101	1016834	1	Accumulator
1102	1016892	1	Pressure gage
1103	1016089	2	*O*-rings
1104	1016735	1	Piston assembly
1105	1016088	2	*O*-rings

In effect, going from bottom to top, the accumulator is progressively assembled by item number. Item 1105 is assembled to item 1104. Item 1103 is assembled to item 1102. Items 1102 and 1104 are then assembled to 1101. The completed assembly becomes 1100, when it is correctly labeled through adding a decal. A Bill-of-Materials is useful in production and maintenance. Even though part numbers appear to have been selected at random, they were actually selected according to a List-of-Materials category.

A *List-of-Materials* is a numbering of detail parts according to use. For example, all *O*-rings could be assigned the numbers 1016001 through 1016099. Then, on a List-of-Materials all *O*-rings would appear next to each other. This listing is useful in parts standardization from project to project and in procurement to segregate like items for maximum purchasing economies.

Reviewing Quiz

Draw lines to connect the kind of data (on the left) with its definition (on the right).

1. Bill-of-Materials
2. List-of-Materials
3. Procedures

A. A listing of a system's detail parts in the way that a system is normally assembled

B. The manuals for systems use, repair, and test

C. A numbering of detail parts according to use

Summary of Chapter 7

The entire engineering task is involved in adequately designing, developing, and documenting the project system. The nature of the documentation is governed by the compatability of the customer's requirements with the sellers data generating procedures. Many disciplines other than straightforward design must be followed by project specialists if a unified data structure is to result. The final acceptance and successful utilization of the system by the customer is the major consideration to be satisfied. A successful systems engineering task will be characterized by the minimum data needed by the customer.

Reviewing Quiz 1. A 2. C 3. B

Chapter 7 Progress Check

Draw lines to connect each component of systems engineering (on the left) with its definition (on the right).

1.	Configuration management	a.	The activity by which minimum essential documentation is acquired for system construction
2.	Project engineering	b.	The activity concerned with the resolution of differences at design points where the parallel efforts approach each other and join the assembly
3.	Logistics management	c.	The activity by which technical requirements are controlled through documentation
4.	Data management	d.	The concurrent design-engineering activity concerned with supporting and maintaining the system after it has been delivered to the customer

Draw lines to connect each kind of data (on the left) with its definition (on the right).

5.	Prints	a.	All the data that describe how to use the system
6.	Procedures	b.	All the data that describe what a system is
7.	Listings	c.	Compilations of information needed for a systems limitation

Indicate true (T) or false (F).

8. Systems engineering begins at the beginning of a project. ____
9. Systems engineering becomes a more vital part of a project after the contract has been signed. ____
10. Systems engineering tasks vary greatly from project to project. ____
11. All the supporting tasks of a project must be completed considering the sophistication of the eventual user. ____
12. When possible, drawings for a project should be produced according to an existing system. ____
13. The nature of project documentation should be governed solely by your data generating procedures. ____

14. A successful systems engineering task will be characterized by the minimum data needed by the customer. ____

15. A List-of-Materials is a listing of a system's detail parts sequenced in the way that the system is normally assembled. ____

Circle the letter before the correct answer.

16. The systems engineer uses his systems structure

    a. to determine systems function and sequence

    b. to design requirements imposed by function

    c. both of the above

    d. neither of the above

17. The goals of a project include

    a. satisfying customer needs

    b. producing a product

    c. both of the above

    d. neither of the above

18. In the systems engineering of a technical project, project engineering involves

    a. hardware

    b. software

    c. both of the above

    d. neither of the above

19. In the systems engineering of a technical project, data management involves

    a. hardware

    b. software

    c. both of the above

    d. neither of the above

20. In the systems engineering of a technical project, logistics management involves

    a. hardware

    b. software

    c. both of the above

    d. neither of the above

Answer briefly.

21. What is systems engineering and at what points in a project does it begin and end?

22. Describe the nature and scope of configuration management.

23. Describe the nature and scope of project engineering.

24. Describe the nature and scope of logistics management.

Answers to Chapter 7 Progress Check

1. c	2. b	3. d					
4. a	5. b	6. a	7. c				
8. T	9. T	10. T	11. T	12. T	13. F	14. T	15. F
16. c	17. c	18. a	19. b	20. c			

21. Systems engineering provides a complete design to the satisfaction of the customer. The process begins at or before the beginning of the project – as soon as the organization starts to consider meeting the customer's proposal requirements. It continues until the system has been completed to specifications and until such support materials as spare parts and instruction documents have been provided for.

22. Configuration management – that systems engineering activity by which technical requirements are controlled through documentation – is concerned that every applicable technical facet of the project, from inception to conclusion, be fit into some type of drawing-data control system.

23. Project engineering is that systems engineering activity by which differences are resolved at design points where parallel efforts approach each other and join the complete assembly and by which the designed assembly is directed to a technically acceptable solution. It is concerned with the limiting design parameters of the systems hardware.

24. Logistics management is that systems engineering activity concerned with supporting and maintaining the system after it has been delivered to the customer. The activity begins during the conception and definition phases, when there must be a continual effort to (for example) minimize special parts and complicated test equipment. It continues through the supply of field instruction to the customer.

Midwest University Housing Project

As systems engineer at Midwest University, Jim Arnold had recently been assigned to oversee the development of the university's new 100-unit housing project for married students. This project was to be built on university property and Jim was to put together the overall plan for the project and supervise its execution.

As a first step in handling this assignment, Jim had examined each of the other housing projects at the university and had also visited related projects on other campuses. From this he had been able to develop a list of specifications for what each unit should contain, its size, and its basic layout.

As a second step, he had then outlined each of the several tasks that would be needed in order to complete the construction of the project. Some of these tasks were to be performed by an outside architect while others would be the responsibility of the general contractor.

The final thing that Jim had spent time working on was outlining the service requirements for this project once it was completed and married students were moved into it. Here he had tried to identify the necessary support in such areas as plumbing and electrical work as well as that required of carpenters and painters on the university staff.

Assignment

Evaluate the completeness of Jim's initial planning efforts and suggest any areas that he might have overlooked.

In the steps that Jim has performed thus far, he has concentrated on the areas of

- Configuration management
- Project engineering
- Logistics

The one area that Jim has not dealt with explicitly is data management. Clearly a number of blueprints and procedural documents will need to be developed and maintained if the project is to be completed correctly and if the logistics support is to be supplied at minimum cost.

Jim also needs to go into more detail in terms of relating these various components of the systems engineering task. Such detail would include defining the length of each task, assigning responsibility for that, and establishing benchmarks to measure his own performance and general project performance.

8 PROJECT MANAGEMENT

Quality Assurance and Control

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8 QUALITY ASSURANCE AND CONTROL

Learning Objectives

After finishing this chapter, you should be able to:

- Describe the scope of the quality manager's duties.
- Define quality assurance and quality control.
- Describe the value of managing quality cost data.

The Scope of the Quality Manager's Duties

The section manager as star performer; the section manager as supporting actor

Section managers in the project generally have fairly well-defined niches to fill. Their duties and responsibilities are outlined, their plans are formulated, and they then proceed to satisfy a given need. At some point in the project, each managerial function becomes the dominant one. For example, the estimator is a central project pivot in the initial stages. All the engineering, planning, and managing revolves around the proposed quotation, and he is thus the central character in the project cast. Later, the financial director takes over the center of the stage as the fiscal plans are laid out; then it is the systems engineer, the production manager, and so on. Each, in turn, is the "star" of the show, but rather than leaving the project after his starring role is played, he remains on stage as a supporting player. During the design stages, for example, the estimator is still effective, since he is comparing the cost of the final design against his estimated cost of the original design. He has a vested interest in seeing that his estimate is not exceeded due to "minor changes in design."

The quality manager: a special case

There is one project team member who would be pleased to have only a supporting role, but all too often he becomes an unintentional "star." This is the quality manager. He is responsible for providing guidance to project personnel in minimizing project deviations from plan. If everyone on the project does his job well, his task becomes administrative as he documents the satisfactory testing and acceptance from the detail parts to the finished system. Practically speaking, however, unforeseen things do occur and then quality (as a function) becomes vital. The promptness of quality reaction to trouble is important. The quality function has personnel attached to every operating project function.

- It has quality engineers assisting the systems engineers in determining system reliability.

- It has quality assurance technicians in the gage design section providing guidance, for example, in the design of special fixtures.

- It could even have its own accountant reviewing project quality budgeting to be sure that various sections of the quality group keep within budget and expenditure rates.

Quality personnel in some way review every project movement that can deviate from the plan. They communicate the "error" (or deviation) to the section of the project responsible and ensure that appropriate action has been taken for correction with a provision for the prevention of similar deviations.

Reviewing Quiz

The following checklist contains advice for the new quality manager. Cross out any bad advice.

1. The quality manager should confine himself to testing finished products.

2. The quality manager should react promptly to trouble.

3. The quality manager may have subordinates in other sections of the project.

4. The quality manager should document the acceptance of everything from detail parts to the finished system.

5. The quality manager should see that deviations from plan are communicated to the responsible section of the project.

6. The quality manager should see that appropriate corrective action is taken.

7. The quality manager should take steps to see that deviations do not recur.

Reviewing Quiz — You should have crossed out only item 1.

The Purpose of Quality Assurance

There are two main aspects of the quality manager's job: quality assurance and quality control. We shall discuss each in turn.

Key Term

Quality Assurance

That function of quality management concerned with the forecasting and prevention of quality problems.

Focusing Quiz

Keep in mind this definition, as well as what you have read about the scope of quality management, as you examine the following statements. Circle each one that you think is true.

The relationship between quality assurance personnel and the customer

1. Quality assurance personnel serve initially as communications links between the customer and the project.

2. They outline project quality requirements regarding customer quality needs.

3. Does the customer want a "mean time between failure" of 200 hours of life? Quality assurance personnel supervise the life test to be sure that the product can do the job.

4. Does the customer want the product a certain shade of blue? They set up a paint chip as a mutually agreed upon color standard to check the final paint application.

5. Project assurance personnel establish a data link with the customer's quality personnel to ensure that both sides can agree on product standards of performance.

Focusing Quiz

You should have circled each of the statements. The quality assurance personnel can be each of these links between customer and project. These personnel also serve other functions, as the succeeding text shows.

The responsibilities of quality assurance personnel within the project

This quiz concentrated on the role of quality assurance personnel as liaisons with the customer. But these personnel also serve functions within the project. There they review systems engineering, production, procurement, and every other phase through their own specialists in the function they serve. Their specialist in systems engineering may be a reliability analyst who performs analyses on alternate designs in an attempt to project how long the particular design will perform its function without correction. The quality assurance specialist in production may be a gage analyst who recommends using tooling types that do not require periodic rechecking, or possibly using only a few important product dimensions as gaging points. The specialist in procurement may be an experienced machinist who can determine solely by vendor plant inspection whether a vendor can meet a given delivery date and expected product quality level.

Quality's functions extend from the vendor's procurement of raw material, through the manufacturing process, to use of the product at the customer's installation. They therefore have a staff organization that parallels the project organization. The quality assurance organization, in this context, does not originate or produce the product. It monitors and performs a control function. It shares a responsibility with quality control in test and evaluation.

Reviewing Quiz

Each pair of statements about quality assurance contains one statement that is accurate and one that is not. Shade in the box containing the accurate statement.

1. Quality assurance personnel create the original design.	2. They examine the original design for flaws.
3. Quality assurance personnel produce the product.	4. They monitor production.
5. The quality assurance staff organization is concentrated in one place.	6. The staff organization parallels the project organization.

Reviewing Quiz

You should have shaded in boxes 2, 4, and 6.

Let us now focus on the way in which quality personnel go about their testing and evaluating. Every engineered product will have components that have been specifically designed by the engineering group. The product itself may be intended for a specific application. Design can only document what the best approach is to the problem. In order to prove that this approach will meet the customer's specifications, it is often necessary to test. The setup of the test itself, the selection of test equipment, and the actual running of the test may be conducted by engineering, but the monitoring of the test data and certification of the data accuracy are in the hands of the quality group as a "disinterested" party. Their function is not primarily to prevent chicanery (although occasionally this is the attitude that manifests itself), but rather to ensure that the test data does in fact substantiate – or refute – the test objectives. As a "disinterested" group, they might point out that the "successful" test is actually a failure since the test engineer forgot to document his objectives fully.

Incident

As you examine the following incident, consider what you have just read about the role of quality personnel in testing.

As agreed, the hydraulic accumulator was tested. The objective was to ascertain that the system could stand 12,000 psig of load. And it could, the designer said with a smile. According to the test data, the system did not fail when pumped up to 12,000 psig. His smile faded, however, when the monitoring quality engineer pointed out that the system had to hold 12,000 psig at an ambient temperature of 300°F., which was far above the 70°F. ambient at which the test was. He regarded making another test as a waste of time and money. Sure enough, a successful rerun of the test at 300°F. vindicated the designer's knowledge that it would pass.

Was the quality engineer right in insisting on the second test? What would you have done if you had been in his position?

See response to the Incident at the bottom of page 8.

The Purpose of Quality Control

Key Term

A second aspect of quality management

Quality Control

That function of quality management concerned with detecting and reporting quality problem occurrences.

The two kinds of quality control in production

Quality control in production may be considered to be in two major sections: *in-process,* which is concerned with the actual production of the system (repetitive controls), and *management data,* which is concerned with the component testing and design changes of the system (once-through controls).

The function of in-process controls

The in-process controls are those established to check repeatedly on important attributes of the system. They involve the normal incoming inspection tools, manufacturing processes, gages, and final acceptance tests. The results of all these tests should be documented and analyzed not only for defective dimensions and parts, but also for trends that may eventually result in defective parts.

The function of management data controls

Management data control personnel may not be as well known, because they set up historical records of component design test data and system design change effectivity. In effect, management data control is a central data repository for the results of design, development, and production of the system.

Complexity generally follows size. As the size of the project increases, it becomes more complex. As it becomes more complex, more things can and do change.

Since quality personnel parallel the project functions, they are in an ideal position to gather and record the results of every experiment and design change. This activity can be most important, as history is one of the better guides to the future.

All rejections and deviations are recorded, as well as the disposition of the deviation. In the solution of many problems, one of the prime questions is: "What is different about this failed item as compared to those that were accepted? What is happening now that didn't happen before?" If a deviation is found, it should be possible through adequate quality management data controls to determine the extent of the deviation within other similar systems.

Incident

The quality engineer was right. It is his job to make sure that objectives are documented fully. Without the second test there would have been no guarantee that the hydraulic accumulator was up to spec.

Analyzing Quiz

Are you sure of the distinction between in-process controls and management data controls? The two examples on the right each illustrate a type of controls. Draw lines to indicate which type.

1. What were the results of that tensile test we ran on that new aluminum alloy six months ago? Since quality assurance monitored the test, quality control will have a copy of the test data in their files. That data might show that this alloy could be used in another application.

A In-process controls

B Management data controls

2. What was the serial number of the system that had the new accumulator material? A check of the records shows that it was only fifty systems prior to the one that failed a special corrosion test. This could mean that the problem of replacing the accumulators is minor and would include every one of the fifty defective accumulators, because we have the serial number of every unit that is affected.

See answers at the bottom of page 10.

Every engineering documentation change order must be approved by the responsible quality representative as a notification that proper changes have been or will be incorporated into any effected production process. A part dimensional change which is not followed up by an appropriate change in the gage to measure the part can result in much confusion. This approval procedure will be followed through all the project software prints, manuals, instruction sheets, and so forth.

The size of the quality personnel group charged with historical recording responsibilities is a function of project complexity. A large missile development project may have several dozen people in addition to a computer to keep track of vendor parts deviations, not to mention other groups involved with data on engineering design, manufacturing, testing, and field service.

Reviewing Quiz

Cross out each of the following functions that is not a part of management data controls.

1. Testing

2. Recording rejections

3. Recording deviations from plan

4. Approving documentation change orders

See answers at the bottom of page 10.

Incident

Pacific Pharmaceutical: building quality into new products development

Consider what you have just read about quality assurance and quality control as you examine the following incident.

As part of its corporate plan for long-term growth and expansion, Pacific Pharmaceutical had recently developed a new product in the catheter area. This was a disposal catheter that could be used in hospitals and doctor offices for such things as taking blood samples and injecting fluids and drugs directly into the bloodstream.

To handle the development of this new product and get it into production as quickly as possible, a project team had been established. Because of the importance of sterility and other quality aspects of such a product, Ian Davis had been assigned as quality manager on the project team.

In his assignment as quality manager, Ian had identified several areas in which he could play an important role in assuring the quality of this product. These included

- Establishing specifications for acceptable tolerances of each product produced.
- Selecting materials for the product that could most easily meet the specifications and hold their sterility.
- Planning lot sizes for production that could be handled quickly and effectively.
- Analyzing proposed production processes to ensure that the final process selected could be adequately controlled and monitored.
- Evaluating alternative packaging design to ensure that the product continued to meet the standards after it was shipped from the company.
- Developing a procedure for doing sample testing of finished units.

What is your appraisal of the program outlined by Ian Davis?

Analyzing Quiz — Both 1 and 2 are examples of management data controls.

Reviewing Quiz — You should have crossed out only item 1.

The Management of Quality Cost Data

Few things in life are absolutely predictable. At best, we attempt to achieve an optimum average when we design, develop, and build a product. When the original estimate was constructed, an allowance for development, retest, debugging, and production rework was incorporated because as practical managers we know that there would always be deviations from plan. A measure of your success as a project manager is how well you minimize these deviations. In Chapter 6, we noted that financial planning allowed a theoretical level of mistakes. We define mistakes here as any actions which do not directly assist in achieving a project goal. In the context of this definition, then a test which shows that a given metal alloy is too weak for the intended design purpose is a "mistake." Actually, a case may be made for the viewpoint that this failed test is really a success because it pointed out a potential failure before the alloy was used in the design. There is nothing wrong with this perfectly valid engineering evaluation of the test, except that it did not *directly* achieve the project goal of a satisfactory design.

Carrying this definition a step forward, a change in gaging that prevented repetitive holes from being drilled undersize, although in

Incident

There are two areas with which Ian Davis must deal as quality manager on the new catheter product. These are quality assurance and quality control. Of the several items included in Davis' list of areas to deal with, all but the final one represent aspects of quality assurance. It appears that he has done a good job of anticipating those areas that will have an impact on quality and taking an active role to ensure that they will be handled in such a way that the necessary quality will be achieved. However, Davis has not completed his job in the area of quality control. This area deals with the measurement and monitoring of quality once the product is being produced. Sample testing of finished units would clearly not be adequate for this type of a product. Davis needs to set up a systematic plan for testing quality at various stages and also a 100% test of sterility at the end of the production process. In fact, this could be made most complete by actually doing the testing after the product has been packaged. He could then do spot testing of returns from customers in order to ensure that quality is maintained over the life of the product.

itself a real and necessary step to minimize costs, became categorized as a deviation because funds were expended to have the gage made.

> The problem to be resolved is how to minimize deviations or mistakes. As a manager, the best measurement standard available to you is cost. In your financial planning, accounts may be established that pertain to quality creation, quality maintenance, internal quality, and external quality costs.

The following checklist shows some of the headings that might appear under each of these five accounts. Check each heading that might apply to a project you could be working on in your present organization. If you wish, refer back to the Dry-Run Project you developed through the first five chapters.

Quality Creation

These accounts may cover headings such as the following:

- [ ] Vendor control
- [ ] Planning and implementing test; inspect and process control procedure
- [ ] Design review
- [ ] Training and education
- [ ] Review of material handling and packaging

Quality Maintenance

- [ ] Calibration and repair of test equipment
- [ ] Field testing of products
- [ ] Procedures audit
- [ ] Failure analysis
- [ ] Data maintenance
- [ ] Audit of corrective action

Internal Quality

- [ ] Scrap
- [ ] Rework
- [ ] 100 per cent sorting of suspected material
- [ ] Material review board activities
- [ ] Production facilities downtime due to re-setups
- [ ] Extra vendor advice

External Quality

- [ ] Field complaints
- [ ] Customer allowances for rejections
- [ ] Product service and repairs

In any of these accounts, additional cost impacts can occur, such as travel to vendors, corrective engineering, customer reports, and construction of test devices. The listing can be as complex or as simplified as the project to which it is applied. Reports must be generated by the quality group to show not only the costs of these "deviations" to the project but also the costs of obtaining the data on the "deviations." Economics is the main criterion. It does no good to put out a report showing $100 per week scrap loss if it costs $1000 per week in quality labor to obtain these costs.

Figure 1

A cumulative report on scrap and rework

Rework Costs – September

Department	Labor/ Month	Cumulative Labor	Rework Labor/ Month	Rework Cumulative Labor
Machine shop	$100,000	$1,000,000	$5000	$50,000
Coil department	20,000	80,000	2000	10,000
Assembly department	40,000	250,000	4000	20,000

Analyzing Quiz

A quick analysis of Figure 1 shows that the machine shop rework costs of $5000 per $100,000 spent appears to be a constant factor, since the percentage of $50,000 rework labor to the $1 million total machining labor spent since the project started is the same percentage as this month's rework costs.

Are the current month's ratio of rework costs to cumulative costs for the coil department higher ☐ or lower ☐ than the cumulative rework costs?

Are the current month's rework costs for the assembly department higher ☐ or lower ☐ than the cumulative rework costs?

Check the appropriate box in each of the above statements. Use the space below for any calculations.

Analyzing Quiz

The coil department's ratio rework costs to cumulative costs are lower for the current month. Over-all, they are $\frac{\$10{,}000}{\$80{,}000} = \frac{1}{8}$.

For the current month, they are $\frac{\$\ 2{,}000}{\$20{,}000} = \frac{1}{10}$, a lower fraction. Calculating the same way for the assembly department, the current ratio is higher.

Now study Figure 2:

Figure 2

Part Defect Costs

Department Coil Department   Project 8016

Date September

Reject Report	Number of Pieces	Part Number	Defect Type	Defect Cause	Labor Dollars	Losses in Material Dollars	Total Dollars
C-321	8	614001382	8	42	$ 80.00	$ 20.00	$100.00
D-420	4	614002649	10	42	50.00	10.00	60.00
H-360	40	722003819	6	30	300.00	100.00	400.00
G-816	15	761001333	35	16	285.00	63.00	348.00
D-419	6	761008764	22	42	16.00	5.00	21.00
Totals					$731.00	$198.00	$929.00

Analysis of this figure shows that the coil department apparently has been having a rash of operator error in soldering (cause 42) during September. A quick check of the personnel roster shows that several new transfers were made that month and possibly a retraining program is needed.

Another chart showing costs classified by cause instead of part number may be helpful as an indication for corrective action.

The actual method the project manager selects to display the costs incurred in quality control is subjective. Personal evaluation, intuition, and continuous project observation will be used to create most of these charts. Interesting things begin to become apparent too. The manager may find that the total cost of producing a given number of items added to the cost of 100 per cent inspection and the cost of replacing the rejected material may be less than the cost of a similar analysis using higher in-process test quality levels and reworking rejected items.

Reviewing Quiz

Check your recall of what you have just read about the management of quality cost data as you fill in the following blanks with the missing words.

To find mistakes, you need a standard, and the best available standard is (1) ____________________. To this end, accounts may be established that pertain to quality creation, quality maintenance, (2) ____________________, and (3) ____________________ costs.

Design review and training are two heads that may come under the

(4) ________________________ account, while procedures audit and

failure analysis are two heads that may come under the

(5) ________________________ account.

There are four rules which may be followed in the analysis of quality cost data:

1. If the number of dollars spent on corrective action, quality audits, and so forth shows a decrease in project scrap-rework and other "deviations" greater than the cost of achieving the decrease, keep spending those dollars. On the other hand, if it costs more in quality control dollars than the hoped for results, do not spend the money.

In some cases, it might be cheaper to do 100 per cent dimensional inspection rather than set up an expensive over-all checking device for automatic checkout. Remember that quality should not *cost* the project dollars; it should *pay* the project dollars – and a properly oriented quality cost data structure will do this.

2. Publicize the results of quality cost data throughout the project.

An operator of an automatic screw machine may not be motivated by craftsman's pride in his work, but he surely should be motivated if someone points out to him that his inattention last week cost the project $800 in scrapped material.

3. Be as careful of low expenditures for quality as you are of high.

A few dollars not spent in calibration of test equipment could be a tipoff that you are in for serious trouble later if rejections occur due to inaccurate test equipment.

4. Spend your quality money where it counts. If a given set of products accounts for 80 per cent of your budget, try to spend most of your dollars there and not on the 20 per cent that is left.

This "rule," like the others, is a generalization. It may be that the 80 per cent gives you no trouble, whereas the 20 per cent is the

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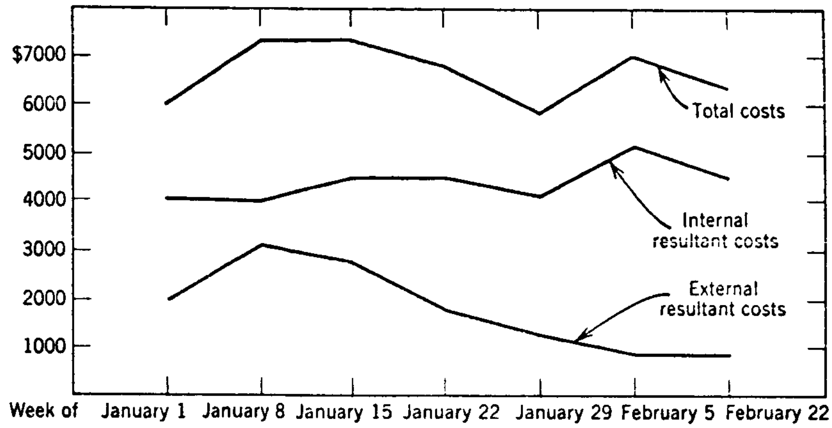
Reviewing Quiz 1. cost 2. internal quality 3. external quality 4. quality creation 5. quality maintenance most troublesome. Act accordingly – but be sure that your actions are justified before you do.

A final thought to remember: program money should be spent for quality to perform its function well. The manager can only know if this expenditure is justified if quality efforts show a continuing effect upon the product. This effect can best be shown by a continuous plot of quality costs versus time.

Figure 3

Quality costs



This particular plot shows that external costs went up in January but later headed down as the vendors became more aware of the incoming inspection quality levels. Internal costs went up and seemed to have stayed in one place except for a brief binge as a result of a poor machine setup man who was transferred in about the end of January, but transferred out a week later.

Reviewing Quiz

The following checklist contains items relating to the preceding rules about the management of quality cost data. Put a check next to each item that conforms to those rules.

☐ 1. Always be willing to spend the money for an extensive quality checking device.

☐ 2. The primary aim of quality control is to keep expenditures as low as possible.

☐ 3. The primary aim of quality cost data management is to keep expenditures low, no matter what.

Reviewing Quiz

You should not have checked any of the items.

Incident

The Western Steakhouse Chain: manipulating inventory as a means of controlling quality

Consider the rules for analyzing quality cost data as you examine the following incident.

Since its founding in 1970, the Western Steakhouse chain of restaurants had grown rapidly every year. This had involved the building of approximately 10 new units each year since 1972. In building those units the company would set up a project team to work in that geographical area and get the unit built and onstream as early a date as possible.

An integral part of the project team's assignment was setting up a quality control system in each location that would assure that the chain's standards were being met in both food quality and service quality. One of the items being proposed for the newest Western Steakhouse involved the storing of only a 3-day inventory of each of the major food items on the menu. This would assure the rotation of those raw materials and avoid unnecessary spoilage or the possibility of serving bad products.

While most of the other restaurants carried 5 or 6 days of inventory of each major item, in those other locations there were occasional complaints that the food was not up to standard when actually served or that food had to be discarded because it spoiled before it was used. The project team felt that moving to the 3-day inventory plan would solve this problem.

What is your reaction to this proposal?

____

____

____

____

Incident

While shifting to only 3 days of inventory of each of the raw materials going into the major meals served at the Western Steakhouse may solve some of the potential quality problems, it will probably be much more expensive than its value. One of the problems that is likely to arise is that service will in fact deteriorate because the restaurant may not have on hand a certain item when a patron requests it. (There is undoubtedly a lot of fluctuation in the rate at which various meals are demanded and thus 3-days worth of supply may in fact get used up in a single night if there is an unusually large demand for that particular product.) This deterioration in service may be more expensive in the long run than having to discard food that is no longer usable.

In order to avoid serving bad food, it would be much better to have a quality checking program that actually determines how long products have been in the inventory and compares that with an estimate of the shelf life for that food. These items should then be discarded in order to avoid serving a bad meal. If this were done on a daily basis, it may solve the quality problem at minimum cost.

Summary of Chapter 8

Quality is part of an over-all project environment and should not be confined solely to those people bearing "quality" somewhere in their job title. The quality group itself parallels all project activities and monitors every project decision. It documents all changes, corrections, and test results, thereby serving as the project historians. Quality cost data is used to improve project performance and minimize deviations from financial planning. Cost accounts should be set up to determine economics of quality control activities. Quality reports issued should contribute to the economic health of the project.

Chapter 8 Progress Check

Fill in the missing word or words.

1. The ______________________ is responsible for providing guidance to project personnel in minimizing project deviations from plan.
2. ______________________ is concerned with the forecasting and prevention of quality problems.
3. ______________________ is concerned with detecting and reporting quality problem
4. ______________________ quality controls are concerned with the actual production of the system.
5. ______________________ quality controls are concerned with the component testing and design changes of the system.

Indicate true (T) or false (F).

6. The quality section may have its own accountant reviewing project quality budgeting. ____
7. In one way or another, quality people should review every project movement that can deviate from the plan. ____
8. It may be the responsibility of quality assurance personnel to see that the customer has the proper testing equipment. ____
9. The quality section may have a staff organization that parallels the project organization. ____
10. Quality assurance personnel may not monitor production. ____
11. In-process quality controls are once-through controls. ____
12. Management data quality controls are repetitive controls. ____
13. Every production documentation change order must be approved by the responsible quality representative as notification that proper changes have been or will be incorporated into any effected production process. ____

14. Quality cost data is used to improve project performance data and minimize deviations from financial planning. ____

15. Cost accounts should be set up to determine economics of quality control activities. ____

16. Quality reports should contribute to the economic health of the project. ____

Circle the letter before the correct answer.

17. Testing is the responsibility of

    a. quality assurance personnel

    b. quality control personnel

    c. both of the above

    d. neither of the above

18. Testing is the responsibility of

    a. in-process controls personnel

    b. management data controls personnel

    c. both of the above

    d. neither of the above

19. Historical records of component design test data are kept by

    a. management data controls personnel

    b. in-process controls personnel

    c. both of the above

    d. neither of the above

20. Historical records of system design change effectivity are kept by

    a. management data controls personnel

    b. in-process controls personnel

    c. both of the above

    d. neither of the above

Answer briefly.

21. What are the quality manager's responsibilities?

22. What kinds of tasks are performed by quality assurance personnel?

23. What kinds of tasks are performed by quality control personnel?

24. What is the main objective of quality cost data management? How can it be achieved?

Answers to Chapter 8 Progress Check

1. quality manager
2. quality assurance
3. quality control
4. in-process
5. management data
6. T 7. T 8. T 9. T 10. F 11. F 12. F 13. T 14. T
15. T 16. T
17. c 18. a 19. a 20. a
21. The quality manager is responsible for providing guidance to project personnel in minimizing project deviations from plan. If everyone on the project does his job well, his task becomes administrative; he documents the satisfactory testing and acceptance from the detail parts to the finished system. Practically speaking, however, unforeseen things do occur, and then quality must come to the assistance of the troubled section. To do this, quality management has personnel attached to every operating project function.
22. Quality assurance personnel perform two main tasks: They serve as communications links between project and customer – outlining customer quality requirements, supervising tests, and the like. They also serve a function within the project – reviewing every phase of the operation.
23. Quality control in production may be considered to be in two major sections: in-process, which is concerned with the actual production of the system (repetitive controls), and management data, which is concerned with the component testing and design changes of the system (once-through controls).
24. The main objective of quality cost data management is to minimize deviations or mistakes. The measurement standard for this is cost. In financial planning, accounts may be established that pertain to quality creation, quality maintenance, internal quality, and external quality costs.

9

PROJECT MANAGEMENT

Procurement, Contract Management, Production

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9 PROCUREMENT, CONTRACT MANAGEMENT, PRODUCTION

Learning Objectives

After finishing this chapter, you should be able to:

- List the main tasks to be performed by a project's procurement section and describe the ways in which these tasks require procurement to interact with other sections.
- List the main tasks to be performed by a project's contracts section and describe the ways in which these tasks require contracts to interact with other sections.
- List the main tasks to be performed by a project's production section and describe the ways in which these tasks require production to interact with other sections.

Procurement, contracts management, and production can be structured as separate project functions. They can be handled by the project manager when project limitations do not require their separation, but in larger projects each of these functions could require a sizeable organization. Procurement could use the talents of lawyers, engineers, quality control personnel, and technicians, in addition to those of the businessman who directs the procurement office. Contracts management could use the talents of attorneys, semanticists, and technical writers. Production needs for personnel talents is another across-the-board requirement. The acceptable full-time project organization size, however, should be minimized, even though specialized talents could be an advantage. In order to minimize expense when these specialized skills are needed, it may be wise to use consultants, either from within the organization or hired for short periods from outside organizations.

Focusing Quiz

Consider this definition, as well as what you have already learned about project management, as you complete the following quiz. Each of the two pairs of statements about procurement contains one statement that is true and one that is not. Shade in the box containing the accurate statement.

1. The procurement manager follows the exact instructions outlined in his requisitions.

2. Project complexity requires as much know-how and resourcefulness in procurement as in other sections of the project

3. The procurement section must have the expertise to resolve purchasing crises.

4. The operating groups, such as engineering, hold primary responsibility for purchasing.

The Nature and Scope of Procurement

Key Term

Procurement

The purchasing function, expanded to cover over-all market and vendor analysis

Traditionally, operating groups resist any increase in purchasing responsibilities.

A project requires a procurement manager with knowledge and ingenuity if an adequate flow of optimum, usable materials and services is to be maintained, especially during a severely compressed production cycle. Purchasing for a project of any degree of complexity must be more than an order-following function. It extends into procurement and materials management. Operating groups such as engineering and production often insist that they can direct who will do what and which vendor should supply what item. This attitude is quite satisfactory for a simplified product line or one that allows an extended production cycle; but what happens when a crisis arises with a "suggested vendor"? The following checklist contains some of the purchasing crises that can arise. Check the box before each crisis you know has arisen in your organization.

☐ The vendor suddenly gets a large order from another customer and decides that your order can wait until after the large order is completed.

☐ Finds out that he is unable to meet the qualification test requirements after he has accepted your order.

Focusing Quiz — You should have shaded in boxes 2 and 3. The text explains why.

☐ Cannot get a sub-vendor to supply his plant in time to meet your project delivery requirements.

☐ Charges you for repair of tooling which you paid him to build on a prior order.

☐ Tells you that he will repair a rejected product in six months when you need it immediately.

☐ Delivers a part that is not used in the system for three months because of your stock handling methods and then refuses to repair it when it fails since it is "out of the warranty time period."

When crises like these or others arise, the operating departments do not have the expertise and cannot take the time to solve them. It quickly becomes apparent that the purchasing function must be more than just an order placement service.

Practically speaking, procurement will attempt to prevent these problems as a normal course of business. How do they do it? By following a complete systems approach to product procurement. They are concerned with the selection, purchasing, use, installation, and service of the vendor's component as part of the project product.

Analyzing Quiz

These extensive responsibilities of the procurement manager begin — as do the responsibilities of most other section managers — in the conception phase of project management. Keep in mind what you have already read as you examine the following statements about the procurement manager's role in this initial design phase. Circle each statement you conclude is true.

1. The procurement manager has a representative on the project management team.

2. The procurement manager serves as a project link to the outside world.

3. Procurement debriefs the vendor after each meeting.

4. Procurement clears potential vendors to visit the project to discuss possible business.

5. Procurement documents what transpires between project personnel and vendors.

6. Procurement has the power to contractually bind the project to buy from a particular vendor.

How the project manager can control the flow of materials costs

The project manager delegates to procurement the responsibility for spending a great protion of his project funds. He must have control over these funds. Through procurement as the only acceptable data link to vendors, he can be relatively certain that no dollar leakage is going to occur through engineering or production independently buying materials. Thus, the manager's control is established mainly through procurement procedures. The placing of orders with vendors can only occur through the procurement office by means of a properly completed requisition. This requisition can only be considered properly completed after the project manager has approved it.

Procurement evaluates every suggestion made for buying material and in addition verifies the accuracy of the buying data transmitted to it. It asks:

- Is the print complete in every detail in order that misinterpretation of dimensions cannot happen?
- Has the suggested delivery schedule been meshed with project production requirements?
- Does the contractual "boiler plate" need altering for specific project needs?

"Boiler plate" is used here to refer to the fine print on the back of the purchase order. This covers the kind of details included in the following checklist. Check the box before each detail that might assume some importance on the kinds of projects handled by your organization. The boiler plate indicates

☐ Who pays for the maintenance of special tooling and who owns it.

☐ Procedure for cancellation of purchase orders for various conditions of non-delivery, poor quality, and so forth.

☐ Provisions for warranty of product after it has been delivered.

☐ How and where the product shall be tested for compliance with specifications.

Analyzing Quiz

You should have circled all the statements. The procurement manager's responsibilities may be every bit as extensive as this.

☐ Mutually agreed upon standards for quality.

☐ The rights of the customer to inspect in-process during product manufacture.

☐ Documentation and data control.

Procurement also originates many product and process suggestions since it is continuously sampling the market place for the newest and latest. Has there been a smaller valve designed that will do the same job as the one that engineering suggested? Procurement will probably know about it. Is there a new alloy that can be substituted with consequent increase in strength and reliability? Procurement can obtain a free test sample and can probably convince the vendor to run special tests, if it can be shown that the vendor could eventually benefit.

In general, procurement's contribution to the initial design effort is a real and necessary one. It can be measured by one of the best criteria available – dollars. Every dollar saved at this point is multiplied by overhead, burden, and profit factors in the final selling price. The amount of multiplication is dependent upon how the organization costs out its product. Some organizations charge an overhead factor to materials; some do not. A dollar saved in raw material may represent five or six dollars in sales volume. This point alone justifies the modern expansion of "purchasing" into "procurement."

Reviewing Quiz

In order to serve all these functions, the procurement section's personnel must have many kinds of knowledge. Check the box before each of the following areas that has been suggested in the text to be important to procurement.

☐ 1. Materials testing

☐ 2. Accounting

☐ 3. Warranty laws

☐ 4. Contracts

☐ 5. Print interpreting

☐ 6. Scheduling

Reviewing Quiz

Again, all the answers are correct. The procurement section's concerns are extremely broad.

Key Term

Materials Management

The responsibility for stocking material and for production control

A tendency to interlock responsibility can create a problem avoidance technique.

Materials management goes even further in its impact upon project activities. The entire flow of material from vendor, through the project, and out to the customer is the responsibility of the materials manager. Blurring the responsibility line between procurement and production is not a novel idea. Throughout the entire project, the management philosophy of extending one section of the project into another should always be pushed. A financial director who does not "understand" production or a production manager who cannot follow "what those engineers upstairs want" can lead to trouble. This trouble, characterized by one group dropping the ball because some problem was not their strict responsibility can, in turn, lead to project failure. However, whether you, as a project manager, want or need to stress the idea of material control is a decision based upon the project size and complexity.

Reviewing Quiz

How do the materials manager's responsibilities differ from the procurement manager's? Give the appropriate kind of manager in the blank.

"If I had been a (1) ____________________ manager, I could have picked up that material without half so much trouble. All I would have really needed would have been the project manager's nod. As a (2) ____________________ manager, I can advise, I can verify, and I can authorize. But production plays a more important role."

Incident

Jack Rand: the significance of procedures

Consider what you have just read about the materials manager's responsibilities as you examine the following incident.

As materials manager for a new chemical product still in the early production phases, Jack Rand had recently had a major confrontation with the Production Department. The production manager had approached Jack and asked him to order two carloads of a basic raw

Reviewing Quiz 1. materials 2. procurement material from a nearby vendor. The production manager wanted the materials so that he could stay on schedule with the first production batch of the new chemical. (Prototype batches had been run earlier but this was to be the initial production run.) While Jack felt that things were almost ready to go, he did not have the final approval from project engineering to place the order. When he checked with them and mentioned the production manager's request, project engineering had suggested that he wait another week so that they could run some final tests on the new product.

As it turned out, the production manager had had to do some last minute rescheduling in order to keep his people and equipment busy. However, Jack felt that he had been correct in waiting since it now appeared that some minor modifications in the raw material would be recommended by project engineering.

Was Jack Rand right or wrong in not placing the order as requested by production? Does whether or not the final findings of project engineering recommend a change in raw material affect how right or wrong he was?

Incident

As materials manager for this new product, Jack Rand clearly needs to have a final release from project engineering before ordering production quantities. Whether or not a final change was to be recommended in the raw materials, he still needs to wait for that approval. Thus he was correct in telling production management that they would have to wait and that the schedule would need to be changed. One of the things that Jack might have done is tried to anticipate this change in schedule and work more closely with project engineering in monitoring when the raw material could actually be ordered. If he had communicated this progress to production management, then it is much less likely that they would have been approaching him to place the order before it was actually ready to be released. Since Jack's job involves one of interfacing between other people, he needs to be particularly aware of the impact of his actions on those other people, and he should try to minimize any negative impact.

Procurement Decisions: Whether to Make or Buy

Focusing Quiz

Whatever the extent of his responsibilities or the nature of the project, the procurement manager will have to count make-or-buy decisions among the most important he will have to consider. On what would you base make-or-buy decisions if you were the procurement manager of a project based on the principles of this course? Answer this question by checking the box before each statement with which you agree.

☐ 1. Proprietary items should be bought.

☐ 2. Take great care in deciding whether to make or buy items and services that the parent organization supplies.

☐ 3. Avoid organization politics at all costs.

☐ 4. Keep historical records of a prospective vendor's quality performance.

During the initial design phase of the project, a continuous informal make-or-buy decision process is followed. Those sections of the product design that involve standard hardware, proprietary items, or partially finished raw material, such as "I" beams or cold rolled steel plate, would of course be bought. The make-or-buy decisions become involved with those items and services that the project's parent organization normally supplied to other consumers and would like to supply to the project.

Decisions to make or buy can be based upon several criteria, with many of the inputs being supplied by procurement:

Quality

Delivery

Politics
(project, vendor, and customer)

Price

These criteria are not necessarily all inclusive or listed in the order of importance for every project, but they will suffice for now. In evaluating these criteria, the project manager must judge whether his

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Focusing Quiz — You should have checked boxes 1, 2, and 4. You will find more about these points in the following text.

own project (or organization) capability can (or has the need to) match the capability of some vendor. These considerations can become complicated, but because the manager has the primary responsibility for making a profit (and will document every decision thoroughly), he must maintain his objectivity and judge every action strictly with respect to its effect upon the project.

Comparisons of quality and delivery can be handled by normal and logical means. A checklist of product characteristics to be measured and a historical record of the prospective vendor's and the company's quality performances are beginning points for the quality evaluation. Delivery schedule evaluation is fairly well cut and dried, except for historical investigation of past performances so far as schedule achievement is concerned. Of course the proposed delivery schedule in any case must coincide with the project needs.

Politics involve that delicate balancing of the project's needs against those of the customer and those of a valuable vendor.

The "politics" of project management require human relations skills.

For example, when top management in your organization wants to know why the project is buying a gyroscope from XYZ Company when the organization makes a comparable product at a comparable price, it will be a problem to explain that the customer demands a tight delivery schedule and you know from associates in the gyroscope division that their delivery is six months behind. Conversely, if you decide the other way, and your customer wants to know why you are buying the gyroscope from your parent organization instead of the XYZ Company, since the customer knows the parent organization is six months behind schedule, it can be quite a problem to explain that through the return of a personal favor, the gyroscope division management is putting your order ahead of someone else's. There are no cut-and-dried answers to the "politics" problem. The rules of logic, educated self interest, ethical treatment of all concerned, and finally, detailed documentation of your project decisions can eliminate most problems in this difficult human relations area.

Production pricing should include provisions for rework, scrap, and reinspection for the organization's products. The manager should calculate all costs that will provide a finished usable component as part of the system. The vendor's price should include incoming inspection costs, return to vendor allowances, and other handling costs. These other costs may include transportation costs to visit the vendor's plant, on-site inspection costs, and liaison costs. There is no provision needed for rework or scrap, since the vendor must deliver a satisfactory product and has undoubtedly included any rework costs in his quotation. The main procedure to follow in price comparison is to factor both the parent organization's price and the vendor's price up to the point-of-use position.

Reviewing Quiz

There are different components, then, for your parent organization's price and a vendor's price for an item. Indicate what some of these differences are by drawing lines to connect the kind of supplier (on the right) with the price component (on the left). A component may refer to both kinds of supplier.

1. Return to vendor allowance	A. Vendor's price
2. Inspection costs	B. Parent organization's price
3. Scrap costs	

Procurement Decisions: Dealing With Vendors

Focusing Quiz

As in the make-or-buy decisions, vendor selection becomes more involved as the complexity of the product or service being produced increases. Still, there are certain common rules that a procurement manager can follow in selecting a vendor. Put a check before each of those rules that appear in the following checklist. Do not check any item that constitutes bad advice.

- ☐ 1. Always select the vendor who offers the lowest price.
- ☐ 2. Always select the vendor who has in the past come up with the best products.
- ☐ 3. If necessary, request objective evidence of the vendor's ability to document progress.
- ☐ 4. If necessary, assist the vendor in procuring raw materials.

Reviewing Quiz — 1. A 2. A, B 3. B

Focusing Quiz — You should have checked items 3 and 4, but not items 1 and 2. The following text explains these answers.

The supplier of a relatively simple item, like standard screws, must have demonstrated that he will meet the material requirements and that he will deliver the least expensive product on time. But when the vendor being considered proposes to supply a space capsule for an interplanetary flight, the investigative process becomes quite involved, and the procurement manager in effect becomes a subproject manager with his own evaluation team of engineers, expediters, quality assurance representatives, and financial control people. It may even appear in some cases that the vendor product itself is secondary with the capability of the vendor organization as the primary consideration. If the contract is a cost plus fixed-fee type with the state of the art to be pushed back, it is very important that the vendor have adequate experienced engineering, complete financial control, a knowledge of the quality standards, and an understanding of the contractual requirements. Since there are very few catalogues of space capsules, the vendor must have the ability and the desire to meet specialized needs exactly.

Procurement should be able to coordinate the efforts of project personnel in developing a check sheet for every aspect of the vendor's organization. Objective evidence of the capability to produce must be documented for adequate vendor selection. Some of the more obvious questions asked are the following:

Documenting the vendor's capabilities

1. Can the vendor's management team supply any needed progress reports such as PERT or Line-of-Balance?

2. Does the vendor have the financial backing to carry the operations or will he need progress payments?

3. Does the vendor have an adequate internal quality control program that can, for example, identify nonconforming material?

4. Is the vendor's internal documentation complete enough to correlate with yours in tracking down trouble areas?

The mark of a good procurement organization is its ability to identify, beforehand, most potential problem areas and either resolve them or supply the manager with enough data for him to resolve them. This might involve setting up a team of expediters to assist the vendor in procuring scarce raw material or running special tests on the vendor's product to assure that the project is getting adequate quality levels.

One of the more difficult vendor areas explored by procurement is the "character" of the vendor's management team. There has never been, nor will there ever be, a purchase order written that covers every possibility in a vendor-buyer relationship. It is these remote possibilities that can either cause the most trouble or allow the project to operate smoothly.

Incident

Here is one example of a vendor's business character:

The customer had a control unit assembled into his system. When he tested it in his plant, it proved out satisfactorily; however, under the environment of the final user, out in the dirt and grime of the field, a short circuit in a switching device developed from the wearing away of an insulated wire.

Legally and contractually, the customer might have had no comeback, since he had agreed with the control unit design and accepted it. However, the bottom tier vendor of the switching device agreed to rewire his unit to preclude the problem. The control unit maker, as second tier vendor, then added a dust cover to the assembly of the switching device in the control unit. Finally, the customer, at his own expense, retrofitted all of his major systems with these two improvements.

What might have been the vendors' motives in acting as they did? How might you have responded in a similar situation?

Incident

Although it might be said that this display of "character" by the vendors was in their self interest because it could lead to further business, this is not always the basic reason for decent behavior. Words such as ethics, morality, the desire to do the right thing, come more easily to mind in many instances when further business would be quite tenuous. As in your own project performance, the willingness of a vendor to cooperate, within reason, even though he is not contractually bound, is a prime requirement for success. Procurement can best evaluate this need from its experience in the field.

On the other hand, procurement often acts as a buffer between the project and the vendor. Occasionally, the vendor is smaller and less able to resist demands for excessive noncontractual requirements. In these cases, procurement, because it is the sole contractual link between the project and the vendor, should point out that the project is in error and that this demand upon the vendor must either be retracted or paid for out of project funds.

Reviewing Quiz

Stop now and review what you have read so far about vendor decisions by the procurement section. Circle each of the following statements that is true.

1. On complex projects, the procurements section can have expediters, quality assurance representatives, and financial control people.

2. A good procurement section should be able to pinpoint most of the problems that might arise with a particular vendor.

3. The procurement section should be able to anticipate all problems that might arise in a seller-buyer relationship.

4. The procurement section should be able to coordinate the efforts of project personnel in developing a check sheet for every aspect of the vendor's organization.

See response at the bottom of page 16.

Analyzing Quiz

From what you have read so far, you may have drawn a conclusion: Procurement is the main data link between the outside world and your project. It supplies various information to the specific project sections that need it. The following checklist consists of examples – which may or may not be true – of kinds of information procurement might supply and to whom it might supply this information. Check the box before each statement that is true.

☐ 1. Project finance is told what the dollar savings or, in rare cases, overexpenditures will be beyond project allocations for material.

☐ 2. Quality control is told what vendor provisions for quality link-up with the project have been made.

☐ 3. Engineering is told what the latest vendor product performance specifications are.

☐ 4. Contracts management is told about PERT vendor performance in order to meet project needs.

☐ 5. Production is told what delivery schedules to expect for subsequent assembly and testing.

☐ 6. Project management is informed about vendor attitudes, cooperation, and general performance.

See response at the bottom of page 16.

Any or all of these data links many contribute toward a successful vendor-project relationship, and it is procurement's task to ensure that any vendor failure in these areas is minimized as far as project impact is concerned. Second-sourcing (defined as obtaining at least two adequate sources of supply for each item purchased) and/or vendor assistance are two additional ways of minimizing vendor failures.

Incident

Steven's Camera Company

Consider what you have just read about procurement decisions as you examine the following incident.

For two years, the Steven's Camera Company had maintained a project team working on the development of a new industrial high-speed camera. The project team included Mike Freedman who had come out of the company's Procurement Department. His assignment was to handle the procurement of major subassemblies and parts for the new camera.

Recently, some question had developed as to the appropriate supplier for the lens and optic subassembly for this camera. The company desired to have only a single source initially and was considering a small aggressive firm, Candid Optics, or the U.S. Lens Company, a division of one of the Fortune 500 firms. U.S. Lens had a strong reputation in the field.

As procurement member of the project team, Mike had spent considerable time evaluating these two options. It was his opinion that while U.S. Lens was much more widely known, that in fact their quality had been deteriorating in the past couple of years and that their costs had been increasing due to a capacity problem. Candid Optics on the other hand was young and eager to grow and seemed to have attracted a very capable set of technical and production personnel.

After an in-depth analysis, it was Mike's assessment that Candid Optics would be the better, long-term supplier of the lens assembly for the new camera. However, the project manager felt that it would be much less risky to give the contract to U.S. Lens. In the event that there were problems on either the cost side or the delivery side with U.S. Lens, the project manager felt that he would be better able to justify his decision, given the nature of that company's reputation and the reputation of the parent firm. On the other hand, if the contract was given to Candid Optics and there were any problems of delivery or cost, he felt that that basic decision might be considered unwise since they were a relatively newcomer to the field.

Reviewing Quiz — You should have circled items 1, 2, and 4.

Analyzing Quiz — You should have checked all the boxes.

As Mike Freedman with the assignment of procurement responsibility for the new camera, what would you recommend?

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The Nature and Scope of Contracts Management

Key Term

This discussion of contracts management — the second of three major topics in this chapter — owes much to Contracts Management, *internal unpublished document, Kearfot Division, General Precision Inc., Little Falls, N.J., 1964.*

Contracts Management

That function of a project which is responsible for conformation of performance to the stipulations of the contract.

Focusing Quiz

Draw on the above definition, as well as on what you have already learned about the broad responsibilities of section managers in general, to answer the following quiz about the duties of a contracts manager. Check the box before each statement that is true.

☐ 1. During the proposal stages, the contracts manager prepares, reviews, and approves the contract terms and conditions.

Incident

If Mike really feels that Candid Optics offers the better source of supply for the longer term, then he should clearly recommend that. However, he should be aware of the concerns of the project manager and thus he might set up a plan for monitoring Candid Optics and their progress on the supply of the lens subassembly. This would allow him to quickly determine the development of any technical or cost problems and thus move towards their solution while they are still small problems. Alternatively, Mike might propose a dual sourcing recommendation for this camera and actually develop both sources of supply. This would have the advantages of competing vendors and allowing more flexibility in actually ordering the production run quantities. However, it may also be somewhat more costly to administer since it requires having two vendors develop the production skills necessary to make this unit.

☐ 2. During the performance stages, he coordinates all project-customer contacts and serves as the main liaison link. He also is the project "secretary" and sees that any verbal commitments, agreements, or changes are recorded in writing and acknowledged both by the customer and by the project manager.

☐ 3. If he feels that the selected vendor or vendors are not performing appropriately, he may go out and make arrangements with alternative vendors to replace them.

☐ 4. At the conclusion of the project, he coordinates the preparation of close-down insofar as the customer is concerned.

The precontract responsibilities of the contract manager

Before the submission of the proposal to the customer, the contracts administrator coordinates the proposal presentation to conform to the expressed needs of the customer. He determines the following, for example:

- Special requirements (packaging, inspection, consultation, scrap disposition)
- Type of contract
- Cash flow needs (progress payments)
- Default and delivery clauses
- Patent and proprietary data clauses
- Penalty clauses
- Security clauses
- Type and quantity of reports

During negotiations with the customer, he supervises requotes, pricing, acceptance terms, cost breakdowns, and any conditions not covered by the customer's request for proposal. When the contract is received, he circulates it to the proper project functions for comments and approval. The legal staff now has an opportunity to determine if

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Focusing Quiz

You should have checked items 1, 2, and 4. Item number 3 would not normally fall within the range of responsibility of the contracts administrator. If the situation requires the replacement of a vendor, then the problem would generally go back to the procurement manager in order for him to determine who is the most appropriate alternative source and to negotiate an agreement with that source. Once the new agreement was arranged, it would again be turned over to the contracts administrator.

there are any legal flaws in the contract. Production now must state that it definitely can or cannot meet the delivery schedule. The same applies to engineering, quality, and other functions.

Reviewing Quiz

In order to serve all these precontract functions, the contract section's personnel must have at least an acquaintance with many kinds of knowledge. Check the box before each of the following disciplines that has been suggested in the text to be important to contract administration.

☐ 1. Accounting

☐ 2. Law

☐ 3. Data management

☐ 4. Quality control

☐ 5. Styling

☐ 6. Durability

The contract administrator's job hardly ceases once the contract has been signed. All customer correspondence must pass through his hands. He does not necessarily originate, for example, an engineering report on the acceptance test of a sub-system, but he reminds the cognizant engineer that it is due, sees that it is put into recognizable English, and then sends it along to the customer with a letter of transmittal that points out the exact contractual clause being satisfied by the document.

He follows up production on deliveries and schedules. He keeps abreast of program activities in procurement, quality, engineering, and other areas which have effects upon either the customer or his contract. If there is a telephone conversation between the project engineer and the customer's engineer, the contracts administrator is included in the conference call to ascertain that any engineering decisions can be contractually satisfied. There probably is a counterpart on the customer's end of the telephone conversation serving the same purpose, but reporting to the customer procurement office.

He issues all start and stop-work orders, changes in project direction, contractual funding limitations, delivery instructions, and other data initiated or required by the customer after approval by the project manager.

Reviewing Quiz

You should have checked the boxes before items 1 through 4.

An an administrator, his function is as important as any other in the project. He has no real authority over any project function, yet he must act as a major coordinating factor. This requires a highly skilled individual.

He must have a great amount of common sense. He must have patience, fortitude, and a high degree of perserverance. What does he do when he has to work for a technically oriented project manager who does not think that it is important to document the results of every test he runs, even though the contract calls for it? Persuasion and in-house salesmanship become prime requisites. He must have an alert, analytical, and inquiring attitude with the ability to think nontechnical problems out to logical answers. Although he must be a master of his job and know cost proposals, contract types, and pertinent customer regulations, the ability to obtain the respect of project personnel is the personal attribute that he needs most.

He might act as "devil's advocate" in prenegotiation project meetings and attempt to poke a hole in the logic of the presentation to be made in order to test presentation validity. Conversely, if a customer requires tasks to be performed that the contract manager feels are not within the scope of the contract, he must insist that the tasks not be done until they are formally documented, in order that later charges to the customer can be made.

His function as a project historian is as important with respect to the project-customer interface as is the quality control group's with respect to the product design. Nothing can occur contractually without complete contracts management documentation.

Incident

Selecting a contracts administrator

Could you use what you have just read to select an appropriate contracts administrator? The following incident may help you to find out.

As project manager of a new aircraft engine just entering production, you are now at the stage of selecting a contracts administrator. Your procurement manager has already selected the appropriate vendors for various components and raw materials and you now need someone to supervise and coordinate the delivery of those components and parts in order to meet production schedules and requirements and still keep raw material inventories at acceptable levels.

The Personnel Department has suggested that Allen Anderson might be the appropriate candidate for you. Allen has a background as an engineer (industrial engineering) and has spent the last three years working as the production planner in the plant's major assembly section. In that task, Allen has been responsible for determining production plans for each of several product lines such that marketing requirements would be met and production capacity would be utilized effectively.

In your interview with Allen, you determine that he has probably been quite good at interfacing with the Marketing Department and at being able to distinguish between blue sky estimates and realistic forecasts. However, you find that he does not have an extensive background in cost accounting and that while he is particularly good at investigating specific problems when an assignment is made, he has not originated very many investigations on his own.

How would you evaluate Allen for the position of contracts administrator on the new engine? (Specifically, what are his strengths and weaknesses in terms of acquired qualities and skills?)

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The Nature and Scope of Production Management

The third and last major theme of this chapter

At some point in the project life span, it is time to produce the product in quantity. In Chapter 3, complete action plans were laid out. Labor costs were equated against investment in automatic equipment in order to determine the least expensive method of manufacture. Production cost (price) is a powerful evaluation tool, assuming that the product is under normal quality controls.

Using the data supplied by procurement in respect to vendor's delivery schedules, production can now calculate its financial require-

Incident

Given Allen's background, he will undoubtedly have a strong set of technical skills for dealing with the production problems at both the sources of supply and the company's own production group. His experience in dealing with marketing as a production planner and coordinating efforts should also qualify him well for contracts administrator duties.

The technical areas in which he will probably be weak are those of cost accounting and procurement skills. However, these can probably be developed over time. In terms of personal qualities, he probably meets the requirements along the lines of negotiating, coordinating, and documenting. However, he will need to develop his abilities to more quickly identify potential problem areas and analyze and resolve those before they develop into major problems. In summary, Allen is probably the right kind of person to be a contracts administrator, but he needs to have a personal development program outlined for him so that he can grow into that role effectively.

ments for labor and material. This calculation is slightly different from that performed in Chapter 6, because it is done by production as an independent cross-check of the financial plan. A projection can be made of actual production lots. These are set up to meet the customer's requirement at a minimized set-up cost.

Reviewing Quiz

One of the following two statements about the interrelationship of production with other sections is true, and the other is false. Circle the true statement.

The production section relies on procurement's delivery schedule.

The production section relies on the financial section's financial plan.

Analyzing Quiz

This quiz is more difficult than the other quizzes you have taken. It calls upon you to consider many of the things you learned earlier in this course.

The Situation:

Let us assume that the customer's product requirement is fifty units per month. If the production flow time for 300 units is seven months, we will have problems during the project. We will define production flow time here as the amount of time a product is in the manufacturing process — now how long the process actually takes. It may take 10 minutes to machine a housing completely, but set-up time, size of production lot, and inspection time may cause a group of 300 housings to have a production flow time of three weeks. The customer will consume the 300 units in six months and need more units faster than the project can deliver them. Production flow time is not linear, since it consists of lot size multiplied by unit operation time (the 10 minutes) which is fixed, set-up time (which is inversely related to lot size), and waiting time between operations.

lot size production flow time = (unit operation time X lot size) + set-up time + waiting time between operations

The Evaluation:

How would you go about meeting the customer's requirement at a minimized set-up cost?

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Reviewing Quiz — You should have circled the first statement.

Analyzing Quiz

At first glance, it might appear that the best direction would be to increase lot size if the set-up time is appreciable. However, there are many other variables, such as ease of lot material movement, size of samples checked during statistical inspection, machine loading and manpower loading; the only real way to determine lot size is to plan a materials flow for each lot on a cut and try or heuristic basis. Attempt to select a lot size so that all the variables of vendor supply, customer needs, and internal production are minimized. When this lot is determined, the capital requirements for production at any given future point can be outlined for such program needs as progress payment. A minimized progress payment projection will result from using the customer's delivery schedule and a Line-of-Balance chart. A Line-of-Balance chart can be laid out by time periods (weeks, months, and so forth) and expenditures projected by the amount shown under the line.

Summary of Chapter 9

Procurement's activities have a directly measurable effect upon project profitability. A dollar saved here can be as important as five or six dollars in sales. Procurement is the only contractual link to the vendor and it ensures that the material is delivered on time within budget.

Contracts management is the data link with the customer. It ensures that appropriate legal language in the contract is complied with by the project. It maintains a historical file of the project-customer interface and protects the project in cases where additional work is required by negotiating additional dollars.

Production plans final operations to ensure project plan fulfillment. Minor adjustments in funding, lot sizes, and methods can contribute in large part to the project's success.

Chapter 9 Progress Check

Fill in the missing word or words.

1. ______________________ is the purchasing function expanded to cover over-all market and vendor analysis.
2. ______________________ involves the responsibility for stocking material and for production control.
3. ______________________ involves responsibility for stocking material and for production control.
4. The fine print on the back of a contract is referred to as the ______________________ .
5. The ______________________ section should be able to coordinate the efforts of project personnel in developing a check sheet for every aspect of the vendor's organization.
6. At the conclusion of a project, the ______________________ coordinates the preparation of close-down insofar as the customer is concerned.
7. The ______________________ acts as project historian with respect to the project-customer interface.
8. Using data supplied by procurement in respect to vendor's delivery schedules, ______________________ can calculate its financial requirements for labor and capital.
9. Production flow time consists of lot size multiplied by unit operation time, ______________________ , and waiting time between operations.

Indicate true (T) or false (F).

10. In order to minimize expense when specialized production skills are needed, it may be wise to use consultants. _____
11. The procurement manager follows the exact instructions outlined in his requisitions. _____

12. The more complex the project, the better it is that operating groups (engineering, for example) insist on what should be purchased and from whom. ____

13. Procurement documents what happens between project personnel and vendors. ____

14. The procurement manager has more extensive responsibilities than the materials manager. ____

15. Through an entire project, the management philosophy of extending one section of a project into another should be pushed. ____

16. If the parent organization supplies an item or a service, the project should always purchase it there. ____

17. In figuring the cost of purchasing an item from a vendor, liaison costs should be included. ____

18. A purchase order must cover every possibility in a vendor-buyer relationship. ____

19. The contracts manager's job ceases once the contract has been signed. ____

Circle the letter before the correct answer.

20. There should be a separate manager in charge of procurement and contracts management if the project is

    a. large

    b. small

    c. both of the above

    d. neither of the above

21. The procurement manager is concerned with

    a. selection of the vendor's components

    b. installation of these components

    c. both of the above   d. neither of the above

22. On a contract's boiler plate, one might find

    a. procedures for cancelling purchase orders

    b. mutually agreed upon standards of quality

c. both of the above

d. neither of the above

23. Procurement should

a. always select the vendor who comes up with the best price

b. consider project, vendor, and customer politics before placing an order

c. both of the above

d. neither of the above

24. Procurement can use straightforward, logical means to

a. compare quality of and delivery by various vendors

b. evaluate the importance of all aspects of organization politics when selecting a vendor

c. both of the above

d. neither of the above

25. Before the submission of a proposal to a customer, the contracts manager determines

a. cash flow needs (progress payments)

b. penalty clauses

c. both of the above

d. neither of the above

Answer briefly.

26. What are some of the more important responsibilities of the procurement section? ______________________

____

____

____

____

27. How do the responsibilities of a materials manager differ from those of a procurement manager?

28. What costs should be considered in vendor pricing? In production pricing?

29. What are some of the data links procurement supplies between the vendor and the various sections of the project?

30. What are some of the more important responsibilities of the contracts manager?

31. How does production calculate its financial requirements? What purpose do these calculations serve?

Answers to Chapter 9 Progress Check

1. procurement
2. materials management
3. contracts management
4. boiler plate
5. procurement
6. contracts manager
7. contracts manager
8. production
9. set-up time

10. T	11. F	12. F	13. T	14. F	15. T	16. F
17. T	18. F	19. F				
20. a	21. c	22. c	23. b	24. a	25. c	

26. The procurement section serves as a project link to the outside world. It debriefs the vendor after each meeting. It clears potential vendors to visit the project to discuss possible business. It documents what transpires between project personnel and vendors. And, it has the power to contractually bind the project to buy from a particular vendor.

27. Materials management goes even further in its impact upon project activities than does procurement management. The entire flow of materials from vendor, through the project, and out to the customer is the responsibility of the materials manager. The procurement manager can advise, verify, and authorize, but production plays a more important role.

28. Production pricing should include provisions for rework, scrap, and reinspection of the organization's products. All costs should be calculated that will provide a finished usable component as part of the system. The vendor's price should include incoming inspection costs, return to vendor allowances, and other handling costs. These other costs may include transportation costs to visit the vendor's plant, on-site inspection costs, and liaison costs. There is no provision needed for rework or scrap, since the vendor must deliver a satisfactory product and has undoubtedly included any rework costs in his quotation.

29. Procurement tells project finance what the dollar savings or, in rare cases, overexpenditures will be beyond project allocations for material. It tells quality control what vendor

provisions for quality link-up with the project have been made. It tells engineering what the latest vendor product performance specifications are. It tells contracts management about PERT vendor performance, in order to meet project needs. It tells production what delivery schedules to expect for subsequent assembly and testing. And, it tells project management about vendor attitudes, cooperation, and general performance.

30. During the proposal stages, the contracts manager prepares, reviews, and approves the contract terms and conditions. During the performance stages, he coordinates all project-customer contacts and serves as the main liaison link. He is also the project "secretary" and sees that any verbal commitments, agreements, or changes are recorded in writing and acknowledged both by the customer and by the project manager. At the conclusion of the project, the contracts manager coordinates the preparation of close-down, insofar as the customer is concerned.

31. To calculate its financial requirements for labor and material, production uses the data supplied by procurement in respect to vendor's delivery schedules. This calculation is done by production as an independent cross-check of the financial plan. A projection can be made of actual production lots. These are set up to meet the customer's requirement at a minimized set-up cost.

10 PROJECT MANAGEMENT

Phase - Out

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10 PHASE-OUT

Learning Objectives

After finishing this chapter, you should be able to:

- Describe the problems involved in phase-out.
- Describe the way in which a phase-out plan should be established.
- Describe the way in which a phase-out plan should be implemented.

The Problems Involved in Phase-Out

Focusing Quiz

Well, it is not quite over yet, but you know that it is only a matter of time. It would be nice if all your problems would melt away, but they will not. Instead, new problems are arising. What are they? Read the following items carefully. If, on the basis of your work experience and the familiarity with project management you have gained in this course, you conclude it presents a likely phase-out problem, then check the box.

☐ 1. How to keep project personnel from losing their *esprit de corps.*

☐ 2. How to maintain the same level of communication with the customer, even though he has begun to put in his second team.

☐ 3. How to terminate the project completely.

Because the project does not operate under an administrative cloud of secrecy and one of the basic ground rules of the project is that some day it will end, all the project personnel know the approximate close-down date too. This phase can be very complicated because the manager is losing the main reason for the *esprit de corps* that kept all working together during the buildup and operational phases. The project personnel are beginning to be concerned about the next project instead of paying attention to the present one.

Focusing Quiz — You should have checked boxes 1 and 2. The following text explains why.

However, at the management level, the customer is still very interested in the project because he knows that the requirements for logistics, field support, maintenance, and spare parts will go on long after project production has stopped. His management recognizes that the close-down problem exists, and he is most concerned that it be done in a fashion orderly and logical enough to enable servicing in the future. A sudden or disorderly end to a project can cause him much trouble when, for instance, he wants to order a spare part three years later and nobody can find the pertinent drawings.

This factor at the customer's management level does not alter other decisions his operating groups have made. Suddenly the project manager finds that he is dealing with the customer's second team. The first team who fought and bled with the project during the initial design and development stages begins to "disappear." The first to go (actually to be transferred to other hot spots in the customer's organization) are the design engineers. Their place is taken by the "sustaining engineers," who might be young potentials with only a few years of experience. Major engineering decisions are no longer required; now it is a matter of making sure that any changes are properly documented and followed through for incorporation into the myriad data lists that the project has on file at the customer's facility.

Then the customer's top-notch quality assurance troubleshooters are replaced by inspectors. This change is very obvious since an inspector can only say "yes" or "no" according to a detailed inspection procedure. The quality assurance people who assisted in solving many difficult problems are probably hard at work on the next "hot" project.

Well, let's face it – you, as a project manager, have now accomplished what you set out to do. Your project has delivered, on time, to specifications, within funding limitations. You are a success. You may even exhibit slight signs of senility by speaking with nostalgia about "the old days – last year" when you were working around the clock to solve that last knotty problem. This is great – for about half an hour's discussion over lunch.

Then, because you are a manager, you have to discharge the remaining project responsibilities and determine how to organize the project clean-up team.

The end of a project is nothing like an action in bankruptcy. It is a transitional phase, as important as any other, from full production to sustaining field support, consistent with product or customer needs. It requires another switch in the management style of the project manager; back to the supportive style used when the project was being started. The directive style used in production could be destructive now.

The Establishment of a Phase-Out Plan

As in other project phases, a plan must be set up outlining the tasks to be done and who is to do them. This phase-out plan should be divided into two sections – one section pertaining to the project and one section pertaining to the project-customer interface. Both phase-out plan sections should be approved, respectively, by the extra-project affected interface. The project plan will be approved by the organization's management, and the customer interface plan will be approved by the customer.

Focusing Quiz

The project plan will primarily show your proposed timely release of project personnel back into the personnel pool. How should this be done? The following pairs of statements offer one statement that is recommended policy and one that is not. Anticipate the recommended statement and shade in the box containing it.

1. Release the best personnel first, because they will be the most discontent (the most anxious to find other positions) and so the least helpful to your phase-out activities.

2. Release the least qualified personnel first because they do not have the capacity to perform the extended functions necessitated by a thinned-out staff.

3. Let it be known that you are trying to find new positions for the personnel who remain.

4. Play down the fact that the project is nearly over. "Out of sight, out of mind."

Try to maintain quality by maintaining qualified personnel until the end.

It is to your advantage, as project manager, to release less qualified personnel first. There are very good reasons for this: lesser qualified personnel do not have as much capability and therefore cannot be as well extended as better people can if a temporary need arises. For example, in the choice between an experienced mechanical engineer with ten years of service and one with two years, you would keep the longer experienced man the longest. It might be that during close-down you came across a requirement for a final tensile test that someone had overlooked. By the time the less experienced man had read the tensile machine operating manual (perhaps even found the machine itself

Focusing Quiz — You should have shaded in boxes 2 and 3. The succeeding text explains why.

somewhere in the plant), the more experienced man would have completed the test and handed you his report.

In addition, the better people have probably been with the project longer and are more familiar with its idiosyncrasies and pitfalls. (Besides, you will have enough to do without having to hold some novice's hand at this point. This is not the time to begin a training course.) This procedure is not easy to follow because everyone knows that you are closing down and other project managers with beginning projects would like to have the best personnel they can – as soon as they can.

At this stage in the project cycle, you probably have some knowledge of the succeeding project that your organization will assign to you. It now could become a matter of survival, in order to initiate your new project's prompt staffing, to retain these better people. If the new project does not require the skills of your veteran personnel, it would be wise to make some discreet inquiries to other managers at this time about their taking on your people. This serves two purposes:

- Your people eventually hear that you have been trying to get them placed, and this maintains their loyalty until it is time to go (you hope).

- It puts other project managers on notice that you have a formal release plan approved by top management and they had better not come "pirating" before time.

Checklists

The project phase-out plan will have a checklist of clean-up tasks assigned to appropriate personnel with definite completion target dates. Sample tasks appear in the following checklist. Check each one that could be a clean-up task for a project you might manage for your organization.

☐ Make sure that all completed test reports are adequately filed.

☐ Determine that data and drawings show the latest production changes.

☐ Establish records disposition for those records not forwarded to the customer.

☐ Issue allocations for tool storage and disposition of remaining material.

☐ Identify any open contractual matters, and document them.

☐ Outline the project history and accomplishments.

The customer interface plan is primarily a review of all contractual matters that are still open. Your checklist might include the following. Check each item that might be appropriate for you.

Your contract administrator might be of great assistance on your customer interface plan.

- ☐ The drawing and data requirements to be transferred for field service use at a later date.
- ☐ Final acceptance of all test data.
- ☐ Return of any customer-supplied tooling, test equipment, or bailments.
- ☐ Procedure set-up for spare parts ordering and manufacture.
- ☐ The names of the individuals or offices acting as project data custodians.

As noted before, the customer's approval should be obtained respecting plan completeness. This precludes problems at later dates.

The Implementation of the Phase-Out Plan

As was true in other project phases, the manager now has a thorough and logical plan before him – all he has to do is carry it out, monitoring as he goes. Interestingly enough, even though he may have performed this monitoring function many times throughout the life of the project, this phase can be the most difficult of all. If he is sentimental, he may find a certain unwillingness to let go after all this time. Conversely, if he is of a rigorously practical nature, he may find that he too is seized with the desire to "get on with it" and find out what the next project will be like.

With either extreme, it is possible that the attention to detail and the painstaking management techniques that he has successfully used might not be as carefully applied as before. As a project manager, don't let it happen! The sentimentalist may find that he has overrun his close-down budget. This is not the best way to continue a reputation as a profit maker. The pragmatist may overlook some detail like the forwarding of several critical prints to storage file. This may not be obvious at the project conclusion; but some time later, when he is busily engaged in supervising another project, it can come back to haunt him when a need arises for a spare part and the prints cannot be found.

Continue along as before when you were in the planning phases at the project's beginning and you will have very few problems. Nobody (neither your organization nor the customer) is interested in "rocking the boat" now, so it should be a fairly uneventful close-down – if you continue along as before.

There is one function of your project that could exist even after you have no further duties; this is contracts management. As a practical matter, you may find that there are a few minor paperwork problems that refuse to get finished at the same time as the last unit is shipped. There is really no need for a full time contracts manager to follow up these problems, so they may be turned into a central company contracts "pool" manager, who will supervise not only these minor points, but also those on other closed out contracts.

Incident

Analytical Instruments Incorporated: avoiding disruptions during phase-out

Consider what you have just read about project phase-out as you examine the following incident.

For two years, a project team at Analytical Instruments had been working on the development of various instruments for analyzing chemical substances in laboratories. These instruments were hooked directly to a computerized system developed by an associated but completely independent company. The project team had consisted mainly of engineers working in the design area, two engineers who offered field support in installing new systems that were tailor-made to customer requirements, and a contracts administrator who handled parts procurement and scheduling for the company's production operations.

Unfortunately, the company recently learned that a competitor had developed a new line of instruments that performed the same task but with a completely different technology clearly superior in terms of economic and performance characteristics. Thus the president of Analytical Instruments decided to disband the company's efforts in developing new instruments in this field. As project manager, John Binyon was thus faced with the task of phasing out his project team.

John tried to identify a number of maneuvers that he felt would help to handle the phase-out with a minimum amount of disruption to customers and personnel. These included the following:

1. Assigning ongoing service responsibility for existing customers to the company's field service personnel

2. Assigning two of the field engineers on the project team to field service to help them carry out their ongoing support of existing customers

3. Assigning design engineers to other projects being worked on in the company

4. Assigning the contracts administrator to the procurement group since his long-term ambitions were in the purchasing and procurement areas

5. Developing a list of excess equipment and materials and circulating it to other project leaders

What is your evaluation of John Binyon's plans for phasing out his project? What areas does he still need to concentrate on to implement this effectively?

The Project Manager's Swan Song

There are very few times in this world when it is polite or advisable to blow your own horn. The project manager can do it now, indirectly, without anyone finding fault. The history of the project has been documented internally by quality control and externally (in customer contact) by contracts management. It is now the manager's function to tie the whole thing together into one grand picture. Since he has been with it from beginning to end, it must have been a success, so why not document accomplishments in the following:

Incident

The major task that John is faced with is assigning personnel in such a way that they will be satisfied with their new assignments and that these will fit their long-term career objectives. This involves sitting down with the individuals and helping them to identify those tasks that will best meet their objectives. John can then serve as a coordinator in helping them interview with other project leaders and other functional managers at the company. He also needs to make sure that those areas taking on additional people have budget approval to do so. Similarly, he needs to make sure that top management will allow the equipment and materials that will appear on his excess list to be picked up by other managers in the firm and/or sold as surplus materials in an expeditious manner. Finally, he needs to spend some time dealing with marketing and existing field customers in explaining the level of ongoing support that Analytical Instruments will offer to existing customers to make the transition as smooth as possible.

1. Design, state of the art
2. Test, development, scheduling
3. Production, quality, reliability, tooling
4. Delivery, logistics, data, hardware
5. Profits
6. Personnel, training, workmanship

– or any other achievement of the project. It might be anything of value either from the organization's or from the customer's viewpoint. The size of the history will vary as will the size of the project.

This documentation is necessary for the organization because it serves as a basis for settling any future questions that may arise about the project. It can also serve as a training guide for other project managers. If the manager can use it discreetly as a vehicle for self-promotion, why not do so? If there are doubts in his mind about the advisability of showing that the project accomplished a certain goal such as a design break-through when he really knows that Harry Smith, the project designer, thought it out by himself, he should reread the chapter on accountability. Harry may have been the one to do it (and we would not minimize this point in the report), but the project (and the manager) is accountable for this achievement to top management. If the project had failed, it would not have been Harry Smith who would have been called "on the carpet," – it would have been the manager. Thus, the manager (and his project) therefore have the right to claim "credit" for the design break-through by managing the whole effort well and easily. The general sometimes takes the credit for a victory, even though the troops did all the fighting. If the manager can take the blame – he is entitled to the credit too. As a manager, remember, you are not being encouraged to diminish anyone else's contribution, just not to minimize yours as a manager – and a successful one at that, who managed all these contributions to the project.

Chapter 10 Progress Check

Circle the letter before the correct answer.

1. The phase-out plan should have a section

   a. pertaining to the project

   b. pertaining to the project-customer interface

   c. both of the above

   d. neither of the above

2. The project manager should try to place his personnel in other projects because

   a. his people eventually hear that he has been trying to get them placed and this maintains their loyalty until it is time to go

   b. it puts other project managers on notice that he has a formal release plan approved by top management and they had better not come pirating before time.

   c. both of the above

   d. neither of the above

Indicate true (T) or false (F).

3. After the product has been delivered, the project manager must figure out how to terminate the project completely. ____

4. The end of a project is a transitional phase from full production to sustaining field support. ____

5. The project manager should try to retain his best personnel until the end. ____

6. The project manager should try to keep the project close-down date a secret from all but his closest associates. ____

7. The customer interface plan is primarily a review of all contractual matters that are still open. ____

8. The project phase-out plan should have a checklist of clean-up tasks assigned to appropriate personnel. ____

9. Unlike other project stages, phase-out does not require a complete and logical plan. ____

10. The contracts management section may have responsibilities even after the last unit has been shipped. ____

Answers to Chapter 10 Progress Check

1. c
2. c
3. F
4. T
5. T
6. T
7. T
8. T
9. F
10. T

Comprehensive Test

Indicate true (T) or false (F).

1. In dealing with top management, a project manager should attempt to conceal or minimize problems. ____
2. To be an effective executive, you should do everything possible to be well liked. ____
3. Written reports should be as complete as possible. ____
4. In a functional management system, personnel serving one function, such as sales, almost always have a great deal of professional interaction with personnel serving another function, such as production. ____
5. If a task section manager were administratively qualified, a financial director might recommend breaking down that task into subtasks, which he would then fund and monitor separately. ____
6. In the systems engineering of a technical project, project engineering involves hardware. ____
7. Logistics management is concerned with resolving differences at design points. ____
8. In a cost contract, the contractor has to pay any additional costs out of his own pocket. ____
9. Generally, a consumer-goods customer exerts more direct control over project specifications than a defense customer. ____
10. Customer needs allowing less time for the design, development, and production cycle, in addition to a lessened tolerance for product error and repair, have led to the application of the project management concept in progressively smaller and less complex systems. ____
11. Larger and more intricate activities are more commonly handled through project management. ____
12. A basic idea behind contemporary project management is that a manager and a project are established for a single purpose. ____
13. A project plan may include PERT, LOB, or any other planning device. ____
14. Materials management goes even further in its impact on project activities than procurement. ____
15. Production pricing should include provisions for rework, scrap, and reinspection of an organization's products. ____

16. Contracts management is that function of the project which is responsible for conformation of performance to the stipulations of the contract. ____

17. PERT charts show cumulative schedule shipments. ____

18. In a functional management system, design, development, production, testing, and delivery normally overlap in time. ____

19. Acquisition is that phase of project management during which the customer has possession of the product in sufficient quantity to satisfy his immediate needs. ____

20. The longest path through a PERT network is called the critical path. ____

21. The reserve for a project with a high labor content should be less than the reserve for a project with a low labor content. ____

22. The reserve for a long-term production would be proportionately greater than the reserve for a short-term production project. ____

23. Management by exception may be used to check actual progress against Gantt predictions. ____

24. Definition is that phase of project management which covers all aspects of production and procurement. ____

25. In a cost contract, the contractor must perform the agreed-on services or provide the necessary supplies for the price established in the contract. ____

26. Product and project complexity require as much ingenuity in the purchasing department as in any other section of the project. ____

27. The sudden or disorderly end of a project may cause a customer some difficulty when he wants to order a spare part three years later. ____

28. Procurement is the only contractual link to the vendor. ____

29. One approach to decision making is to ask: What is the problem? ____

30. The reserve for a development project would be less than the reserve for a production project. ____

31. The reserve for a project with a high material content would be greater than the reserve for a project with a low material content. ____

Fill in the missing word or words.

32. Project management, which is the direction and supervision of a project, is typified by the use of ______________ techniques.

33. Within an organization, the project exists as a separate task entity, but it does not exist ______________ .

34. The ______________ section of a quotation might include delivery rate and expenditure rate.

35. Unless the seller's accounting procedures lend themselves to complete and clear cost segregation, he should not sign a ______________ .

36. ______________ are useful in pointing out problems that might be encountered in reaching solutions.

37. Individuals are good at ______________ solutions to problems.

38. The ideal flow of ______________ is modified by individuals in accordance with their own ideas and intentions.

39. In practice, the four phases of a system life-cycle can occur ______________ .

40. The phase-out plan may be divided into two parts, one part will concern the project and the other will concern the ______________ .

41. A ______________ allows the project manager and financial director to measure the rate of expenditure and the rate of completion.

42. In funding a project, one might allocate funds for each task, allowing for a ______________ .

43. The ______________ evaluates suggestions made for the buying of material in addition to verifying the accuracy of the buying data transmitted to it.

44. The activity by which minimum essential documentation is acquired for system construction is ______________________ .

45. The activity by which technical requirements are controlled through documentation is

______________________ .

46. ______________________ refers to the fine print on the back of a purchase order.

47. It may be the responsibility of ______________________ to see that the customer has the proper testing equipment.

48. Quality cost data is used to improve ______________________ data and minimize deviations from financial planning.

49. ______________________ is the informal day-to-day documentation of every decision, every direction, every achievement that a project manager wants to accomplish.

50. At the completion of a project, a project manager's ______________________ may serve as a training guide, in addition to serving as a basis for settling any future questions that may arise.

51. In a project management system, the ______________________ phase ends when enough data has been generated so that an outsider could produce the system.

52. In a project management system, the ______________________ phase covers the entire production and procurement process.

53. Projects should be set up in such a way that problems can be ______________________ and solved before becoming major obstacles.

54. ______________________ is that phase of project management in which a general picture is formed about how to achieve a certain goal.

55. ______________________ is a useful control system when in the production phase.

56. All customer correspondence must pass through the ______________________ department.

57. Once the ______________________ phase begins, a project manager must demonstrate his skill at the plain politics of working with people.

58. A project manager who has only staff authority is essentially without all the ______________________ he could use.

59. One advantage of keeping personnel administration under the control of a ______________________ manager is that it allows part-time personnel to be easily drawn from the organizational pool.

Circle the letter before the correct answer.

60. In establishing up-the-line cooperation, a project manager should

a. adjust the level of his briefings to the level of the audience

b. pass all pertinent information along to people in high places

c. both of the above

d. neither of the above

61. A project manager

a. may dissolve his organization

b. can avoid making major decisions

c. both of the above

d. neither of the above

62. A project manager

a. will always have to sell his ideas

b. can avoid making decisions concerning minor adjustments in his project

c. both of the above

d. neither of the above

63. In a phase-out plan, the project manager may

    a. prepare tooling inventory lists

    b. file completed test reports

    c. both of the above

    d. neither of the above

64. In a revised estimate

    a. the total cost is variable

    b. the task breakdown is variable

    c. both of the above

    d. neither of the above

65. After a contract has been won, it might be necessary to revise an original estimate if the final price were to be affected by

    a. marketing estimates of potential competition

    b. management decisions to buy into a potentially profitable project

    c. both of the above

    d. neither of the above

66. A project financial director may

    a. evaluate estimates

    b. establish controls

    c. both of the above

    d. neither of the above

67. Quality control in production may involve

    a. repetitive controls

    b. once-through controls

    c. both of the above

    d. neither of the above

68. Systems engineering tasks

    a. vary greatly from project to project

    b. may be characterized by the minimum data needed by the customer

    c. both of the above

    d. neither of the above

69. The project manager should not

    a. develop the management abilities of his subordinates

    b. set his goals higher than the customer's needs would indicate

    c. both of the above

    d. neither of the above

70. In seeking suitable personnel for his project, a project manager may

    a. select those persons with the most specialized possible backgrounds

    b. consult a candidate directly, without going through that person's immediate supervisor

    c. both of the above

    d. neither of the above

71. In an original estimate,

    a. the total cost is fixed

    b. the task breakdown is fixed

c. both of the above

d. neither of the above

72. Operations analysis includes

a. the establishment of schedules and cost estimates

b. the formulation of operational and logistic concepts

c. both of the above

d. neither of the above

73. A milestone is

a. a key achievement

b. a terminal achievement

c. both of the above

d. neither of the above

74. Two basic rules of conduct for project managers are

a. do not do it yourself

b. organize your resources to fit the project

c. both of the above

d. neither of the above

75. Some of the components of a quotation are

a. the seller's proposal

b. schedules and contract type

c. both of the above

d. neither of the above

76. To manage effectively, a project manager

    a. needs direct line control of project funds and top management support

    b. should use the maximum amount of control

    c. both of the above

    d. neither of the above

77. There are several reasons for negotiating that are not directly related to the dollar value of the contract. These include:

    a. the establishment of rapport with the buyer

    b. the elimination of arithmetical or descriptive errors

    c. both of the above

    d. neither of the above

78. A project manager should

    a. avoid making decisions unless he has all the information

    b. know as much as possible about his own project

    c. both of the above

    d. neither of the above

79. A LOB flow chart

    a. shows processing time only

    b. can be used to project the funds required at any point in the production cycle

    c. both of the above

    d. niether of the above

80. In conducting successful meetings, one should

    a. generally resist the temptation to dominate the entire meeting

    b. invite the right people

c. both of the above

d. neither of the above

81. A plan provides a manager with a means for

    a. coordinating people and material

    b. measuring progress accurately

    c. both of the above

    d. neither of the above

Draw lines to connect a word with its definition.

82.	Status	a.	accomplishment
83.	Achievement	b.	assignment
84.	Task	c.	identification
85.	Accountability	a.	is the power to make final decisions that others must follow
86.	Authority	b.	is the obligation which results from a person's formal role in an organization, to perform assigned tasks effectively
87.	Responsibility	c.	is the fact of being answerable to superiors for the satisfactory completion of specified tasks
88.	Specifications	a.	are formal statements prepared by the contractor for his customer
89.	Quotations	b.	are interactions between two or more parties for the purpose of coming to terms on some specified matter
90.	Negotiations	c.	are detailed accounts of certain contract items such as quality and performance
91.	Gantt charts	a.	integrate project elements
92.	PERT charts	b.	plot achievements against time

93.	Milestone charts	c.	allow projects managers to see which alternatives are going on simultaneously
94.	LOB flow charts	d.	have milestones called benchmarks
95.	Prints	a.	all the data that describe how to use a system
96.	Procedures	b.	compilations of information needed for a systems limitation
97.	Listings	c.	all the data that describe what a system is
98.	Quality Manager	a.	is concerned with guiding project personnel to minimize deviations from plan
99.	Quality assurance	b.	is concerned with forecasting and preventing quality problems
100.	Quality control	c.	is concerned with detecting quality problem occurrences

Comprehensive Test Answers

True/False Questions

1.	F	17.	F
2.	F	18.	F
3.	F	19.	F
4.	F	20.	T
5.	F	21.	F
6.	F	22.	F
7.	F	23.	F
8.	F	24.	F
9.	F	25.	F
10.	T	26.	T
11.	T	27.	T
12.	T	28.	T
13.	T	29.	T
14.	T	30.	F
15.	T	31.	F
16.	T		

Multiple Choice

60.	c	68.	c
61.	a	69.	d
62.	d	70.	d
63.	c	71.	b
64.	b	72.	c
65.	c	73.	a
66.	c	74.	c
67.	c	75.	c

76. a
77. c
78. b
79. b
80. c
81. c

Matching Questions

82.	c	83.	a	84.	b
85.	c	86.	a	87.	b
88.	c	89.	a	90.	b
91.	c	92.	a	93.	b
94.	d	95.	c	96.	a
97.	b	98.	a	99.	b
		100.	c		

Missing Words

32. control
33. administratively
34. schedules
35. cost contract
36. committees
37. implementing
38. power
39. sequentially, concurrently
40. project-customer interface
41. feedback control system
42. reserve
43. procurement department
44. data management
45. configuration management
46. boiler plate
47. quality assurance personnel
48. project performance
49. project control documentation
50. documentation
51. definition
52. acquisition
53. forecast, predicted
54. conception
55. LOB
56. contract administrator's
57. acquisition
58. autonomy
59. functional